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RESEARCHES ON THE MOLECULAR DISSYMMETRY OF NATURAL ORGANIC PRODUCTS.

By L. Pasteur, Member of the Chemical Society of Paris. Presented to the Chemical Society of Paris, January 20 and February 3, 1860. Translated from "Leçons de Chimie professées en 1860." By W. S. W. Ruschenberger, M. D., U. S. Navy.

INTRODUCTION.

These lectures were prepared on the invitation of the Council of the Chemical Society of Paris. The researches of which they present a rapid summary have occupied me during ten consecutive years. I had often thought of collecting them, of minutely reviewing the details, and adding to them all the developments necessary to the co-ordination of the different memoirs in which they appeared for the first time. But there is in the life of every man devoted to the experimental sciences an age when the value of time is inestimable: this rapid age, in which the spirit of invention flourishes, in which every year ought to be marked by an advance. To stop, then, voluntarily at things acquired, is a restraint and a danger, which the pleasure and even utility of seeing our ideas expand in accordance with our desires too well compensate.

As much as I have recoiled before the laborious task of collecting, of perfecting my researches on the molecular dissymmetry of natural organic products, in the same degree I have yielded eagerly to the prayer of many members of the Chemical Society, to publish the two lectures in which I was charged to set forth the principal results at which I had arrived. Few studies have been better received at the time of their successive appearance, and, nevertheless, I have many proofs that they were scarcely known.

I hope, then, that this publication may be of some use. But should there be nothing beyond the interest which these lectures have excited in the distinguished assembly before which they were delivered, I shall be sufficiently recompensed for my labors.

The Chemical Society has been gratified by the eagerness with which many young men of learning have taken seats among the audience. It has especially marked the sympathetic encouragement given to its labors by the presence of Messrs. Balard, Claude Bernard, Delafosse, Frēmy, Serret, members of the Academy of Sciences.

May I be permitted, moreover, to especially thank, in my name and in the name of the Society, our illustrious President, M. Dumas, whose lofty and benevolent patronage has always served science almost as much as his immortal works.

L. PASTEUR.

Paris, 1860.

FIRST LECTURE.

At the close of the year 1808, Malus announced that light reflected from all bodies, whether opaque or diaphanous, acquired very extraordinary new properties, which essentially distinguished it from light transmitted directly from luminous bodies.

The modification which light undergoes in the act of reflection Malus denominated *polarization*. Later, this was designated under the name of *plane of polarization* of the ray, the plane of reflexion itself, that is to say, the plane passing by the incident ray and the normal to the reflecting surface.

Malus did not limit his discoveries on polarized light to this. It had long been known that a ray of direct light always separated into two white fasciculi, of the same intensity, in its passage through a rhomboid of carbonate of lime. The flame of a candle, observed by the aid of such rhomboid, is always double, and the two images have the same brightness.

Huygens and Newton had observed that light, which has passed through a crystal of Iceland spar, no longer comports itself like direct light. So, looking through a new rhomboid at one or the other of the two images of the candle we have just mentioned: 1. There will not always be bifurcation of the ray: 2. When there is bifurcation, the two new images will not have the same intensity. Light, which has traversed a bi-refrangent crystal, is different, then, from natural or direct light. This admitted, Malus proved that the modification impressed upon light by double refraction was identical with that which reflexion produces from the surface of opaque or diaphanous

bodies; in other words, that the two rays, ordinary and extraordinary, given by a bi-refrangent crystal, are polarized rays.

Malus established so clearly from the beginning, these fruitful discoveries, with so much care and so much precision in his facts and in his language, that one might believe, in reading his memoirs, that they were prepared yesterday. But he could not pursue his work: premature death carried him off in 1812, at the age of thirty-seven years. Happily for science, two celebrated physicists, at that time young and full of activity, MM. Biot and Arago, received his legacy, and were not slow to distinguish themselves by brilliant discoveries in the new route which Malus had just opened to science.

In 1811, Arago observed, that when a polarized ray traversed normally a plate of rock crystal cut perpendicularly to its axis, the ray, on issuing from the plate, if analyzed by aid of a rhomboid of Iceland spar, gives *constantly two images* in every position of the rhomboid; and further, these two images are colored with the complementary tints. When the thickness of the spar does not permit an entire separation of the two fasciculi, the image is white where they are in part superposed.

This experiment presents a double anomaly to the ordinary laws of bi-refrangent crystals. Every other crystal, with an axis cut normally to this axis, would have furnished two white images, in place of being colored, and, in two rectangular positions of the rhomboid analyzer, the images would be reduced to a single one.

The conclusion of Arago was, that the results of the preceding experiment are precisely those which should follow, if we suppose that the differently colored rays of the incident white fasciculus are, on issuing from the plate of the quartz, polarized indifferent planes.

Arago does not recur to these brilliant phenomena, the laws of which M. Biot presented since 1813, carefully isolating them from those among which Arago appeared to confound them.

M. Biot formed the polarized ray successively with each of the simple rays of the spectrum, and found that the plane of primitive polarization was deviated at an angle proportional to the thickness of the plate; that this angle is different for each

simple color, and goes on increasing with the refrangibility, according to a determined law. M. Biot also made the very curious observation that, of the plates obtained from different spieces of quartz, there were some which deviated the planes of polarization to the right and some to the left, following the same laws.

But the most remarkable discovery of M. Biot, in this kind of phenomena, is, without contradiction, that of the deviation imparted to planes of polarization by a great number of natural organic products, essence of turpentine, solutions of sugar, of camphor, of tartaric acid, &c. The first announcement of this fact is found in the bulletin of the Philomathic Society for December, 1815.

For the understanding of this lecture, we should especially notice the existence of the rotary property in tartaric acid, and its absence in paratartaric or racemic acid, an acid which is isomeric with tartaric acid.

There exists then liquid organic products or solutions in water which possess the rotary property, and in this respect remind us of the solid, crystallized quartz. But it is essential to note here that this analogy to quartz is entirely apparent. There was in both cases deviation of the plane of polarization, but the characters of the phenomenon were very different.

Quartz deviates, but it must be crystallized. Dissolved or solid, and not crystallized, it has no action. Not only must it be crystallized, but it must be cut in plates perpendicular to the axis. From the moment the plate is a little inclined in the direction of the ray, the action abates and then ceases.

Sugar deviates, (and what I say of sugar is true of all other organic products), but the sugar must be either dissolved, or solid and amorphous like barley sugar. In the crystallized state it is impossible to discover any action.

The tube containing the solution of sugar may be inclined. The deviation does not change for the same thickness. Further, by violently agitating the liquid by the assistance of a clockwork movement, the phenomenon remains the same.

Thus M. Biot concluded from the beginning, strictly that the action exerted by organic bodies was a molecular action, peculiar to their ultimate particles, dependent upon their individual

constitution. In quartz the phenomenon results from the mode of aggregation of the crystalline particles.

These are the physical precedents, if I may so express myself, of the researches with which I propose to entertain you. Here are their mineralogical precedents.

II.

Hemihedrity* is assuredly, among the peculiarities of crystallization, the one which is the easiest to seize in its external manifestation: consider, for example, a species of mineral crystallizing in the cubic form. This form, as all know, may surround different kinds of determinate forms by the law of symmetry, a law so natural that it is, so to speak, a physical axiom. The expression of this law is, that a form being given, all others compatible with it may be obtained by a contrivance which would consist in modifying, truncating, as Romé de Lisle said, at the same time and in the same manner the identical parts. The identical edges are those which are at the intersection of faces respectively identical, mutually cutting at the same angle; and solid identical angles, those which are formed by dihedral angles respectively equal and similarly placed. For example, in the cube there is but one kind of solid angles and one kind of edges. Let one of the solid angles be truncated by a face equally inclined to the three faces of the solid angle, and the seven other angles should be, at the same time, by a face of the same nature. This is observed in alum, in galena, and generally in all cubic species.

Let us consider a right prism with a rhomb base. The eight edges of the bases are identical. If one is truncated, the seven others should be, and in the same manner. The four vertical edges are of another kind. Generally they will not be truncated at the same time as those of the bases, and if they are, it will be differently.

These examples alone will suffice to explain the law of symmetry and its application.

Nothing is more simple than to have a clear idea of hemihedrity. Experiment has long since shown, Haüy was acquainted with the most celebrated instances, that, in a crystal,

* *Emisus*, half; *edron* side.

the half only of the identical parts are sometimes modified at the same time and in the same manner. It is said in such case that there is hemihedrity. Thus, the cube ought to be truncated at the same time on its eight solid angles. But, in certain cases it is so only on four. Boracite affords an instance of this kind. Under these circumstances the modification occurs in such wise that in prolonging the four truncations in a way to make the faces of the cube disappear, we obtain a regular tetrahedron. If the modification were applied to the four remaining angles it would produce another regular tetrahedron, identical with and superposable on the first, and differing from it only by its position on the cube.

In the same way let us take our right prism truncated on the eight edges of its bases. In certain species the truncation occurs upon half of the edges only, and it also happens here that the truncations, bearing upon edges opposite at each base and crossing at the two extremities, when prolonged, lead to a tetrahedron. There are two tetrahedrons possible, as for the cube, differently placed in relation to the prism, accordingly as it preserves such or such group of four truncations; but here the two tetrahedrons are not absolutely identical. These are symmetrical tetrahedrons. We cannot superpose them.

These notions suffice to show what is meant by hemihedrity, and what is understood by hemihedric faces or forms.

Now, quartz of which we just spoke, is one of the rare mineral substances in which Haüy found hemihedric faces. The habitual form of this mineral, a regular hexagonal prism, terminated by two pyramids of six faces, is well known. It is clear that the trihedral angles situated at the base of the faces of the pyramid are identical, and, consequently, if one of them bears a face, it ought to be reproduced on all the others. This is true of the face termed *rhombiferous* by mineralogists.

But Haüy first remarked, in certain specimens, a face very different from this, which he designated by the letter x, which falls more on one side than on the other, without being double, as the law of symmetry would in this case require. Another very curious peculiarity of these crystals has not escaped crystallographers. It is that the face x is inclined sometimes in one direction and sometimes in another. Haüy, who was fond

of bestowing epithets appropriate to each variety of a species, applied the term *plagihedral* to the variety of quartz having the face *x*. Crystals in which the face *x* inclined to the right, are designated under the name right plagihedrals, the crystal being adjusted in a suitable manner; and those crystals in which the face *x* inclined in an opposite direction are termed left plagihedrals.

Nothing is more variable than this character. Here it exists; there it is absent. Upon the same crystal there are angles which bear the face *x*; others which should have it, have it not. Sometimes we find plagihedral faces to the right and to the left. Nevertheless, all persons versed in a knowledge of crystals, admit that there is in quartz a true hemihedrity in two opposite directions.

Here is placed a very ingenious approximation due to Sir John Herschell, communicated to the Royal Society of London, in 1820.

M. Biot, as I previously said, made the remarkable observation, that among the specimens of quartz, some deviated in the direction of the plane of polarized light, and others in an opposite direction, to the right and to the left. This stated, John Herschell associated the crystallographic observation of Haüy with the physical remark due to M. Biot. Experiment confirmed the idea of a relation, in fact, between the right and left plagihedrals and the right and left optical deviations. Specimens of quartz which bear in one direction the face *x*, deviate the plane of polarized light in the same direction.

Such is an exposition of the principal facts which have preceded the researches, an abridged history of which I have to relate.

III.

When I began to devote myself to particular pursuits I sought to fortify myself in the study of crystals, anticipating that I would derive assistance from it in my chemical researches. The most simple means, it seemed to me, was to take a somewhat extensive work upon crystalline forms, to repeat all the measurements and to compare my determinations with those of the author. In 1841, M. de la Provostaye, whose exactness is well

known, published a handsome work on the crystalline forms of tartaric acid, paratartaric acid, and their saline combinations. I took hold of this memoir. I crystallized tartaric acid and its salts, and I studied the forms of their crystals. But, in my progress, I perceived that a very interesting fact had escaped the learned physicist. All the tartrates I studied afforded decided indications of hemihedric faces.

This particularity of form in the tartrates was not very evident. This may be readily conceived, since it had not yet been observed. But when, in one species, it appeared in doubtful characters, I always succeeded in rendering it more manifest, by recommencing the crystallization and slightly modifying the conditions. Sometimes the crystals bore all the faces required by the law of symmetry, but hemihedrity had credit for an unequal development of one half the faces. This was seen for example in the ordinary tartar emetic. It may be said that what adds to the difficulty in recognising hemihedrity, are the frequent irregularities of crystals which are never easily developed. Hence their results, deformities, arrests of development in this or that direction, faces accidentally suppressed, &c. Except under circumstances almost exceptional, the ascertaining of hemihedrity, especially in crystals of the laboratory, requires a very attentive study. Besides that, although hemihedrity may be possible in a form, although it may be a function of the internal structure of the body, it may not be externally manifest, any more than is found upon every crystal of the cubic species all the forms compatible with the cube.

But be that as it may, I repeat, I found hemihedric tartrates.

This observation would have been barren, probably, without the following:—

Let a, b, c, be the parameters of the crystalline form of any tartrate; α, β, γ, be the angles of the crystallographic axes. These are ordinarily right angles or a little oblique. Besides, the relation of the two parameters, such as a and b, is nearly the same in the different tartrates, whatever may be their composition, the quantity of their water of crystallization, the nature of their bases; γ, alone differs sensibly. There is a kind of semi-isomorphism among all the tartrates. One might say that the tartaric group prevails and impresses a stamp of resem-

blance between these different forms, in spite of the difference of the other constituent elements.

It follows from this that there is something in common in the forms of all the tartrates, and it is possible to arrange them similarly, in taking for example, as character of similar position, the position of the axes a and β.

Now, if the disposition of the hemihedric faces be compared on all the prisms of the primitive forms of the tartrates, arranged in the same manner, this disposition is found to be the same.

Let us sum up in two words these results, which have been the point of departure in all my ulterior researches: the tartrates are hemihedric, and they are so in the same direction.

Guided on the one hand by the fact of the existence of molecular rotary polarization, discovered by M. Biot in tartaric acid and in all its combinations; on the other, by the ingenious approximation of Herschell; in the third place, by the learned views of M. Delafosse, with whom hemihedrity has always been a law of structure and not an accident of crystallization, I presumed there might be a correlation between the hemihedrity of the tartrates and their property of deviating the plane of polarized light.

It is important to seize here the sequence of ideas:

Haüy and Weiss ascertained that in quartz there exists hemihedric faces, and that these faces fall to the right in certain specimens, and to the left in others. On his side, M. Biot found that crystals of quartz are also divided into two groups, under the relation of their optical properties, some deviating to the right, and the others deviating to the left, the plane of polarized light according to the same laws. Herschell comes in his turn, places between these two facts, until then isolated, a line of connexion, and says: The plagihedrals of one direction deviate in the same direction; the plagihedrals of the other direction deviate in the opposite direction.

For my part I find that all the tartrates are plagihedral, if I may so express myself, and that they are all in the same direction. I should then presume that here, as in quartz, there was a correlation between hemihedrity and circular polarization. At all events, the essential differences which I have just noticed

between the circular polarization of quartz and that of tartaric acid, ought not to be neglected.

We are now, thanks to the new facts which precede, and to the approximations which I have just enumerated, in possession of a preconceived idea, (for it is as yet nothing more,) on the possible correlation of hemihedrity and the rotary power of the tartrates.

Very desirous to find in experiment a corroboration of this still speculative proof, my first thought was to ascertain whether the very numerous crystallizable organic products, which possess the molecular rotary property, have hemihedric crystalline forms, which no one suspected, notwithstanding the approximation of Herschell. This investigation had the success which I anticipated for it.

I occupied myself also with the examination of the crystalline forms of paratartaric acid and its salts, substances isomeric with tartaric combinations, but all of which M. Biot found inoperative upon polarized light. None was found hemihedric.

The idea of the correlation of hemihedrity, and the molecular rotary power of natural organic products, gained ground.

I was soon led to develope it clearly by a very unexpected discovery.

IV.

It is necessary to submit here a very remarkable note from M. Mitscherlich, which was communicated to the Academy of Sciences by M. Biot. Here it is:—

"The paratartrate and tartrate (double) of soda and ammonia have the same chemical composition, the same crystalline form with the same angles, the same specific weight, the same double refraction, and consequently the same angle of optical axes. Dissolved in water their refraction is the same. But the dissolved tartrate turns the plane of polarized light and the paratartrate is indifferent, as M. Biot found through the series of these two genera of salts. But, adds M. Mitscherlich, *here the nature and the number of atoms, their arrangement and their distances, are the same in the two compared bodies.*"

This note of M. Mitscherlich deeply interested me at the

time of its publication. I was then a pupil at the Normal School, leisurely meditating on the beautiful studies of the molecular constitution of bodies, and attained, as I thought at least, to a clear comprehension of the principles generally admitted by physicians and chemists. The preceding note disturbed all my ideas. What precision in all the details! Are there two bodies whose properties have been better studied, better compared? But in the actual state of science can we conceive two substances so similar without being identical? M. Mitscherlich himself tells us what was, in his mind, the consequence of this similitude:

The nature, the number, the arrangement, and the distance of atoms are the same. If this is true, what then becomes of this definition of chemical species, so rigorous, so remarkable for the time in which it appeared, given in 1823, by M. Chevreul? *In compound bodies, species is a collection of beings identical in the nature, the proportion and the arrangement of their elements.*

In short, the note of M. Mitscherlich rested in my mind as an obstacle of the first order to our manner of considering material bodies.

Every body will understand now, that, being prepossessed, for reasons stated, with a notion of a possible correlation between hemihedrity of the tartrates and their rotary property, the note of M. Mitscherlich, of 1844, would recur to my memory. M. Mitscherlich, I at once supposed, was deceived upon one point. He could not have seen that his double tartrate was hemihedric, that his paratartrate was not, and if these things are so, the results of his note are not extraordinary; and I would have in it besides the best criterion of my preconceived idea about the correlation of hemihedrity and the rotary phenomenon.

I then hastened to resume the study of the crystalline form of the two salts of M. Mitscherlich. I found, in fact, that the tartrates were hemihedric like all the tartrates which I had previously studied, but, strangely enough, the paratartrate was also hemihedric. Only the hemihedric faces which, in the tartrate, had all the same direction, were inclined in the paratartrate sometimes to the right, sometimes to the left. In spite of all that was unexpected in this result, I did not the less pursue

my idea. I carefully separated the crystals hemihedric to the right, and the crystals hemihedric to the left, and observed their solutions separately in a polarizing apparatus. I then saw with no less surprise than pleasure, that the crystals hemihedric to the right deviated the plane of polarization to the right; the crystals hemihedric to the left deviated to the left, and when I took an equal weight of the two kinds of crystals, the mixed solution was neutral to light by the neutralization of the two equal and opposite individual deviations.

Thus I set out from the paratartaric acid; I obtained in the ordinary way the double paratartrate of soda and ammonia, and after some days the solution deposits crystals, all of which have exactly the same angles, the same aspect to such a degree, that M. Mitscherlich, the celebrated crystallographer, in spite of the most minute and severe study, could not detect any difference between them. The molecular arrangement in the two, however, is entirely different. The rotary power as well as the mode of dissymmetry attest it. The two species of crystals are isomorphous, and isomorphous with the corresponding tartrate; but here the isomorphism is presented with a peculiarity without example up to this time; it is the isomorphism of two dissymmetric crystals which reflect themselves in a mirror. This comparison presents the fact in a very just manner. In fact, if in both species of crystals I suppose the hemihedric facettes prolonged until they mutually meet, I obtained two symmetrical tetrahedrons inverse, and which cannot be superposed in spite of the perfect identity of all their respective parts. Hence I must conclude that I had separated by the crystallization of the double paratartrate of soda and ammonia, two atomic groups symmetrically isomorphous, intimately united in paratartaric acid. Nothing is easier than to prove that these two species of crystals represent two distinct salts, from which may be derived two different acids.

It is sufficient to proceed, as in all similar cases, to precipitate each salt by a salt of lead or barytes, and then to isolate the acids by sulphuric acid.

The study of these acids possesses immense interest; I know none more interesting.

But before submitting it, permit me to present here some notes relative to their discovery.

V.

The announcement of the preceding facts naturally placed me in relation with M. Biot, who was not without doubts about their exactness. Charged with reporting upon it to the Academy, he caused me to go to his place to repeat the decisive experiment under his eyes. He sent to me the paratartaric acid which he had previously studied with particular care, and found to be perfectly neutral to polarized light. I prepared in his presence the double salt of soda and ammonia, which he also desired me to procure. The liquor was left in one of his closets to slowly evaporate, and when it had furnished about 30 or 40 grammes of crystals, he requested me to go to the college of France for the purpose of collecting and isolating, under his eye by examining their crystallographic characters, the right and left crystals, desiring me to declare anew, if I affirmed that the crystals which I should place to his right would deviate to the right and the others to the left. That done, he said he would take charge of the rest. He prepared the solutions in strong proportions, and at the moment of observing them in the polarizing apparatus he again invited me into his cabinet. He first placed in the apparatus the most interesting solution, that which ought to deviate to the left. Even without any measuring, he saw, from the aspect alone of the tints of the two images, ordinary and extraordinary, of the analyser, that there was a strong deviation to the left. Then, with very visible emotion the illustrious sage took my arm and said :—"My dear child, I have loved science so much all my life that this makes my heart beat."

You will excuse, gentlemen, these personal recollections, which will never be effaced from my mind. In our times, with our habits, they should be excluded from a scientific memoir, but they seem to me proper in an oral exposition; and perhaps the biographic interest of similar recollections will constitute one of the advantages of the kind of teaching which the Chemical Society now inaugurates.

Besides, there is more here than personal recollections. The emotion of the sage in M. Biot was mingled with the internal pleasure of beholding his own anticipations realized. For more than thirty years M. Biot had vainly endeavored to induce chemists to participate in his conviction, that the study of rotary

polarization afforded one of the surest means of obtaining knowledge of the molecular constitution of bodies.

VI.

Let us return to the two acids which furnish the two kinds of crystals so unexpectedly deposited by the crystallization of the double paratartrate of soda and ammonia. Nothing, I repeat, is more interesting than the study of these acids.

In fact, one of the two, that which is derived from crystals of the double salt hemihedric to the right, deviates to the right, and is identical with the ordinary tartaric acid. The other deviates to the left like the salt which furnishes it. The deviation impressed by these two acids upon the planes of polarization is rigorously the same in absolute value. The right acid follows in its deviation particular laws which no active body had yet presented. The left acid offers them in the most faithful manner in inverse sense, without a suspicion of the smallest difference.

And the proof that paratartaric acid is the combination, equivalent to equivalent of these two acids, is, that if we mix, as I am about to do before your eyes, solutions somewhat concentrated of equal weights of each of them, their combination is accompanied by a disengagement of caloric, and the liquid solidifies at once by an abundant crystallization of paratartaric acid, identical with the natural paratartaric acid.*

Relatively to their chemical and crystallographic properties, whatever may be done with one of these acids, can be repeated with the other under the same conditions, and in all cases we obtain identical products, but not superposable, products which are as like as is the right hand to the left. The same forms, the same faces, the same angles, hemihedric in both cases. The only dissimilarity is in the right or left inclination of the hemihedric facettes, and in the direction of the rotary power.

VII.

It is manifest, from all these results, that we have to deal with two isomeric bodies, whose general relations of similitude and molecular dissimilitude are known.

*This beautiful experiment called forth applause from the audience.

Bear in mind the definition of chemical species just now mentioned, namely, the collection of all individuals identical by the nature, the proportion and arrangement of elements. All the properties of bodies are the functions of these three terms, and the object of all our efforts consists in recurring by experiment on properties to the knowledge of these three things.

In isomeric bodies, the nature and proportion [of constituents] are the same. The arrangement alone differs. The great interest of isomerism has been to introduce into science this principle—that bodies may be and are essentially different by that alone, that the arrangement of atoms is not the same in their chemical molecules.

But no isomeric bodies existed whose relations of molecular arrangements were known. This gap is filled for the first time by the discovery of the constitution of paratartaric acid and the relations of constitution of the right and left tartaric acids. We know, in fact, on the one hand, that the molecular arrangements of the tartaric acids are dissymmetric, and on the other, that they are rigorously the same, with the sole difference of presenting dissymmetries in opposite directions. Are the atoms of the right acid grouped according to the spire of a dextrorse helix, or placed at the summits of an irregular tetrahedron, or disposed according to such or such determined dissymmetric assemblage? We are unable to reply to these questions. But what cannot be doubted is, that there is a grouping of atoms according to an order dissymmetric to a non-superposable image. What is not less certain is, that the atoms of the left acid precisely realize the inverse dissymmetric grouping of this one. We also know, that paratartaric acid results from the juxtaposition of these two groupings of inversely dissymmetric atoms.

From this moment the ascertaining the resemblances and the chemical and physical differences which correspond to these arrangements whose relations are known, affords particular interest, and gives to the molecular mechanism assured bases. It permits us to establish the connexion of physical and chemical properties with the molecular arrangement which determines their proper existence, or inversely it permits us to recur from properties to their first cause.

These general relations of properties and corresponding atomic arrangements may be summarily stated as follows:—

1st. When the elementary atoms of organic products are dissymmetrically grouped, the crystalline form of the body manifests this molecular dissymmetry by non-superposable hemihedrity.

The cause of hemihedrity is then recognized.

2d. The existence of this same molecular dissymmetry is translated beyond by the rotary optical property.

The cause of rotary polarization is also determined.*

3d. When non-superposable molecular dissymmetry is found realized in opposite directions, as happens in the two, right and left, tartaric acids and all their derivatives, the chemical properties of these identical and inverse bodies are rigorously the same; whence it follows that this mode of opposition and of similitude does not alter the ordinary play of chemical affinities.

I am mistaken: upon this latter point there is a restriction to be placed, an important restriction, eminently instructive. Time would fail me to-day to develope it at leisure and properly. It will find a place in the next lecture.

* Fresnel, by one of those views of genius of which he has had so many has in a manner presented this cause of rotary polarization.

He expresses himself thus, in one of his memoirs, in volume xxviii. of the "Annales de Chimie et de Physique," year 1825:—"Rock crystal presents optical phenomena, which cannot be reconciled with the complete parallelism of the molecular lines, and which would seem to indicate a progressive and regular deviation from these lines in the passage, from one slice of the medium to the next."

(To be continued.)

ON TINCTURA FERRI CHLORIDI.

Read at the Pharmaceutical Meeting of the Philadelphia College of Pharmacy, held Dec. 3d, 1861.

By W. H. Pile, M. D., Philadelphia.

Every practical druggist must be aware of the uncertainty and perplexity attending the preparing of muriated tincture of iron, the more annoying as this arises not from any want of skill on his part. In fact, it is almost impossible to predict the result of his labors, and the conscientious druggist has often the mortification of finding his best endeavors unavailing in obtaining a satisfactory preparation, and his time and materials together thrown away. Numerous methods have been suggested and devised to overcome these difficulties, as may be seen by glancing back over the various Pharmaceutical Journals of our own and foreign countries, some of these no doubt would yield good results, yet in general they are not practical enough for our Pharmaceutists, requiring apparatus which the generality of druggists would rather dispense with.

The object of this paper is to suggest a *modus operandi*, by which a uniform preparation may be secured, independent of those variations of materials, which are unfortunately so often met with.

These variations are with respect to the muriatic acid, it being either too strong, or which is more usually the case, deficient in that particular.

As regards the precipitated carbonate of iron a greater difficulty exists, even when pure; that is, when containing no adulteration. The solubility in acid, of different samples, is exceedingly various, some specimens being almost entirely insoluble, while in the greater number, the digestion and heating calls for the greatest exercise of patience.

This difference of solubility appears to arise from some peculiar state of aggregation, and likewise, according to Gmelin, from its state of hydration or combination with water.

These varying conditions are no doubt caused by precipitating, washing and drying at different temperatures, or a too prolonged exposure to the air.

I have never yet met with a sample, however pure, that would

meet the test of ignition, by which 98 grs. of pure hydrated sesquioxide of iron should lose 18 grs.; and provided it contained protocarbonate of iron, the loss would be so much the greater, as every 58 grs. of this latter substance would determine a loss of 18 grs. additional.

Perhaps it would be well, in order to a better understanding of the whole subject, to look at the officinal formula of our Pharmacopœia, and by means of the necessary tables calculate the relative quantities of acid and iron in the solution.

The formula is as follows:

Take of Subcarb. Iron, half a pound.

Muriatic Acid, (sp. gr. 1·16) one pint.

With directions to digest with heat until dissolved.

Now a pint of water weighs 7291 grs.; a pint of acid will therefore weigh (7291 × 1·16) 8457 grs. According to Ure's tables, muriatic acid, sp. gr., 1·16, contains 31·3 per ct. of chlorine. The pint will consequently contain (8457 × 31·3) 2647 grs. of chlorine.

Sesquichloride of iron, Fe_2Cl_3 has for its composition 56 grs. of iron to 106·26 grs. chlorine, and by proportion the 2647 grs. chlorine require 1398 grs. iron to combine with it.

Again, although there appears to be an uncertainty as to the precise composition of subcarb. of iron, it is generally regarded as a hydrated sesquioxide of iron, Fe_2O_3+2HO, containing a small but variable amount of carb. of protoxide. The equivalent for the hydrated oxide is 98, or when calcined 80. The equivalent of iron in these two forms would be the same, or 56. If the preparation of iron is the hydrated, by means of this proportion, as 56 iron : 98 hyd. sesquiox. : : 1398 iron, we obtain 2446 grs. of hyd. sesquiox. iron as requisite to saturate 1 pint of muriatic acid.

If the iron were anhydrous, the relative amount required would be $\frac{80}{98}$ as much, or 1997 grs. In either case the quantity is considerably less than that given in the formula, namely 2880 grs. Another remark should be made, as still further increasing the disparity between the calculated and given proportions, and that is the considerable escape and loss of muriatic vapors, during the oft prolonged heating and digestion.

This gas is given off freely, even at moderate temperatures,

and more so as the heat is raised, and the watery solution does not become permanent until nearly half of the gas has escaped. Now the quantity of iron dissolved decreases with the loss of acid, and as this depends on the solubility of the iron preparation, some requiring a much more prolonged digestion than others, we have consequently every reason to fear, that this valuable medicinal agent, will be found to vary widely in its therapeutic effects, as well as in its chemical relations.

In the formula of our Pharmacopœia, there is no provision made to compensate for this variation of strength, and even if half the acid should have evaporated, we are still required to add three pints of alcohol to the remainder.

I have already shown that the quantity of acid in the formula, one pint, would require for its saturation 2446 grains of hydrated ox. iron, provided there was no loss by evaporation and escape of gas. On this latter supposition, the whole amount of the finished tincture would measure 4 pints or 64 fluid ounces, and this would give 38 grains* in each fluid ounce. The iron is therefore in excess 434 grs., but as it is not an expensive preparation, it might be safely used to insure against accidental impurities, and also to thoroughly saturate the acid.

A much more important and practical consideration remains to be noticed, namely, how to provide against the loss of acid, or to make a proper compensation for it.

The remedy suggested will fortunately be found useful in a variety of cases, several of which have occurred in my own experience. It is briefly this: After digesting the subcarb. of iron and acid together, until the acid has dissolved all it is capable of, allow it to settle, and pour off the clear solution, or filter if preferred; then evaporate the solution, with a gentle heat until it commences to crystallize upon cooling; now add water until the specific gravity becomes 1·44, when cool. If now found to be turbid from a slight deposit of sesquioxide of iron, add a few drops of muriatic acid, and warm gently till clear; when finished the specific gravity should be 1·44 at 60° Fahr. and it will then

* According to Dr. Squibb's observation there is a contraction in volume when the alcohol is mixed with the solution of iron, of about 2 per cent., which would slightly increase the calculated strength per oz.

yield per fluid ounce, 130·6 grs. sesquioxide of iron by precipitating with ammonia and igniting.

This solution is the "Liquor Ferri Sesqui Chloridi," one fluid ounce of which, when mixed with three fluid ounces of alcohol, will form the Tinct. Ferri Chloridi always of uniform strength, and containing 22·8 grains of iron per fl. ounce. The Dispensatory states, that in the present formula, no excess of acid exists, and, provided the digestion is continued long enough, no excess can exist, as I have already shown. The neutral solution, however, when diluted with alcohol and exposed to the action of light and air, is liable to absorb oxygen and deposit iron. This, perhaps, could be avoided by adding a definite quantity of muriatic acid to the solution.*

I have stated that cases occur, in which the above mentioned method of preparing a normal solution of iron can scarcely be dispensed with without loss.

I allude now to those accidental mishaps which occasionally are met with, even in the best regulated stores; such as the tilting over of the evaporating dish, and consequent loss of a portion of the acid, or the solution being forgotten until nearly dry, &c.; such events occurring, the loss of the residue must follow, if it were not for the remedy still available. In these and similar cases, pursue the same method, pour off and evaporate till the solution commences to crystallize, and then make up to a specific gravity of 1·44 by the addition of water.

In this proceeding, the employment of an accurate hydrometer will facilitate the necessary trials very much, or, still better, the 1000 grain bottle. These instruments are so indispensable, that every druggist should be supplied with them. In situations, however, where they cannot be obtained, an ordinary 2 oz. vial with a narrow neck may be employed with advantage for the same purpose.

In the Prussian Pharmacopœia there is an officinal preparation called *Liquor Ferri-Sesqui Chloridi*, made, however, in a different manner from the one already stated. Its advantages

*A slight excess of acid appears further desirable, as tending to the formation of an ether, which is thought by many to increase the medicinal efficacy of the tincture.

are, its permanent character and its being a pure sesquichloride. It is the solution which I prefer keeping for making the muriated tincture and other preparations.

The formula is as follows, with some unimportant exceptions:

Take of Iron wire free from rust, ℥ii.
Muriatic acid, fl. ℥viii.
or sufficient quantity,
Water, . . . ℥v.

Mix, and digest with a gentle heat, adding more acid, if necessary, until all the iron has disappeared, when the solution is complete add to it half as much more muriatic acid, previously diluted with 3 oz. of water, then raise the temperature to boiling or nearly so, and pour in by successive portions about 2 fl. ℥. of nitric acid, or until a drop tested with a dilute solution of red prussiate of iron, gives neither a green or blue precipitate.* Evaporate with a gentle heat, until upon cooling it begins to crystallize, add 6 oz. water, and if any iron oxide has separated, add enough muriatic acid to re-dissolve it with the aid of a gentle heat. Again evaporate to 6 fl. ℥., and finally add water to make the whole measure 10½ fl. ℥. The sp. gr. of this solution is 1·44, and is of the same strength as the solution previously spoken of, and can be made into the muriated tincture in the same manner.

As connected with this subject I may here remark, that a *Syrup of Perchloride of Iron*, which is occasionally prescribed, may be readily and extemporaneously made as follows:

℞. Liq. Ferri Sequichloridi fl. ℥i.
Syrupi . . . fl. ℥x.

Misce.

This is identical with that prepared by Beral's formula, which is made by dissolving one part dry chloride of iron in 23 parts of syrup.

*The first part of this process is best effected in a flask; after the iron is dissolved, transfer the solution to an evaporating dish, which should not be more than one-fourth full, on account of the extrication of nitrous vapors towards the close, occasioning sometimes considerable frothing up of the materials.

ON BAUME TRANQUILLE.

By William C. Bakes.

It would be supposed that the rapid advancement which Pharmacy has made during the past few years, would render it unnecessary for the pharmaceutist to seek for "specialities" among the discarded formularies of ancient *Pharmaciens;* but such is not the case. Ever and anon some enterprising member of the profession, in his endeavors to meet the requirements of the physician, introduces either an old remedy under a new name, or a modification of an old recipe under its original title.

Some of our practitioners are prescribing a French preparation, formerly much used in this city, but of late years nearly obsolete, and as there seems to be an inquiry for it, I furnish the formula for publication in the Journal, so that if it possesses the merits claimed for it, all may share them alike, and this valuable preparation be restored to the position which it formerly occupied among the much valued class of anodynes.

Baume Tranquille.

Take of Fresh Belladonna leaves.
" Conium "
" Hyoscyamus "
" Stramonium " each ℥iv. ʒiii.
Opium ℥i.
Olive Oil Ovj.

Mix the whole together and boil over a slow fire, strain and add

Oil of Sweet Marjoram,
" Sage,
" Wormwood,
" Lavender,
" Thyme,
" Peppermint,
" Rue, of each ʒix.

As the fresh leaves are not always accessible, the *Baume* may be prepared from the inspissated juices or extracts, in the following manner.

Take of Extract of Belladonna,
" Conium,
" Hyoscyamus,
" Stramonium, each ℥i.
Aqueous Extract of Opium ℥ii.
Dissolve the extracts in a little boiling water, and add
Olive oil, Oiiss.

Strain, and when cool add the same proportion of oils as in the preceding formula.

This process has the advantage of being more expeditious, and furnishes a preparation of equal strength with that from the recent leaves.

A remedy containing the same ingredients, and made in a similar manner, substituting Glycerine for the Olive Oil, has been prescribed under the name of *Baume Anodyne ;* as an application for ear-ache, which the pharmaceutist is frequently called upon to furnish, these preparations answer an admirable purpose, being both prompt and effectual.

ON THE ROOT OF FRAZERA WALTERI.

By W. R. Higinbothom, of Bermuda.

(From an Inaugural Essay.)

The Frazera Walteri, called also American Columbo and American Gentian, is an indigenous plant found along the base of the Alleghany mountains in the southern and western States, and also in Arkansas and Missouri, in great abundance. The root has been subjected to a chemical investigation, with results but partially satisfactory.

The infusion has a bright reddish brown color, an agreeable bitter taste, and a decided acid reaction. Oxalate of ammonia causes a precipitate, and sesquichloride of iron occasions a greenish black color. The solutions of the acetates of lead and of nitrate of mercury immediately coagulated it. Lugol's solution and bichloride of mercury no change. From these tests the presence of *lime, an organic acid, and gummy matter* is inferred, whilst *starch* and *albumen* are absent.

An ethereal tincture made from washed ether had an amber

color, reddening litmus freely, and had a bitter taste. This was evaporated to a soft extract, and treated with boiling water. A yellow mass, consisting of wax, fatty matter, resin and brilliant yellow coloring matter remained undissolved, the latter having a bitter and nauseous taste, and partially soluble in chloroform, oil of turpentine and alcohol. The watery liquid was filtered until transparent; it had a sharp acid, scarcely bitter taste, and on evaporation afforded no crystalline matter. The clear watery acid liquid gave a clear olive green color with sesquichloride of iron, and a bright emerald green with sulphate of copper. Nitrate of mercury, solution of gelatin and a solution of an alkaloid occasioned no change. These reactions prove that the acid is not tannic or gallic, and that it is probably an acid peculiar to this plant. Various experiments were made with a view of isolating it without success.

When the alcoholic extract was dissolved in water and precipitated with subacetate of lead, and the filtered liquor deprived of lead by sulphuretted hydrogen and evaporated, an extract of a pure bitter taste results, which is chiefly bitter extractive. The root after extraction by alcohol and drying, was percolated with cold water. The percolate was nearly black from its depth of color, had a sweetish mucilaginous taste, and, on standing a short time, formed quite a firm jelly, which proved to be pectin associated with glucose.

The chemical constitution of this root is evidently allied to that of gentian, and has nothing in common with columbo except its bitterness, and this is due to another principle. American gentian is, therefore, a more appropriate name than American columbo.

NOTE ON A SOPHISTICATED PRECIPITATED CARBONATE OF IRON.

Mr. Editor,—The following notes, which I made at the time, are at your disposal:

In preparing Muriated Tincture of Iron recently, I was much annoyed at the insolubility of the Prec. Carb. Iron, a new lot which I had just received. After a prolonged digestion of 3 ounces for five or six hours with the requisite amount of muri-

atic acid, I added an additional quantity of acid and continued the digestion several hours more.

A large amount apparently remained undissolved; allowing this to settle, and pouring off the clear solution, I threw the bulky sediment on a filter and washed with water thoroughly. When dried, it resembled white clay, and weighed 1¼ oz., which represents this moderate adulteration as 42 per cent. of the whole weight. But this was not all: upon evaporating the acid solution, together with the wash waters of the sediment, it became encrusted over with a crystalline mass; pouring off the now concentrated solution, and washing the crystals with cold water and drying, I obtained a further adulteration of 80 grains, or nearly 6 per cent. of fine silky crystals, white, and resembling sulphate of quinine. Subjecting these impurities to appropriate tests, it is evident that the first mentioned insoluble residue is alumina, while the crystals are hydrated sulphate of lime deposited from the hot solution.

Can you inform us, Mr. Editor, by what ingenious process this lot of Prec. Carb. of Iron has been manufactured? for I imagine the whole compound has been thrown down together by some unscrupulous chemist, who was more concerned about the quantity than the quality of the article.

Yours, truly,
W. H. PILE.

NOTE ON THE PREPARATION OF CHLOROFORM, AND OF OIL OF CLOVES.

BY THE EDITOR.

Recently at the invitation of Mr. Benjamin J. Crew, of the firm of Crew, Rogers & Crew, manufacturing chemists of this city, the Editor of this Journal had the opportunity of examining the apparatus employed by these gentlemen in the manufacture of chloroform and oil of cloves. The chloroform still is peculiarly located, being sunk in the ground; the top of the still is on a level with the first floor of the laboratory building, whilst the body of the still occupies a circular pit, walled with brick, furnished with a lateral opening into the common sewer, into which the calcareous residue of the process is allowed to escape.

The advantage derived from this arrangement is the saving of the labor and expense of elevating the chloride of lime to the second story, which would be necessary were the still above ground.

The still is constructed of boiler iron, is about six feet in diameter, and eight feet high, surmounted by a dome-shaped top of cast iron, the apex of which is extended vertically by a conical leaden neck to the height of five feet, when it bends and connects with the condensing worm. This consists of 150 feet of inch and a quarter lead tube coiled in a large cask six feet in diameter, the water in which is constantly renewed by a hydrant. There are several lateral faucets to the still at various heights to ascertain the elevation of the contents during the reaction. The dome is penetrated by a manhole through which the charge is introduced, and which is closed afterwards by a clamp and screw pressing on a cast iron plate with gum-elastic cloth beneath. A shower jet is placed within the base of the neck, connected with the hydrant, by means of which an excessive reaction may be moderated, though it is rarely needed. The "charge" of chlorinated lime is 500 pounds. At the side nearly over the still a platform scale is placed, on which a large wooden tube is supported. Into this the chloride of lime is put and mixed by a stirrer with sufficient water to give it fluidity and to break up the lumps, when it is run into the still, by removing a plug in the bottom of the tub directly over the manbole of the still. Seven and a half gallons of 95 per cent. alcohol are then introduced, and immediately after the remainder of 200 gallons of water requisite for the charge. The opening is now closed, and steam admitted so as to blow directly into the still from the pipe which enters near the bottom, so that in its exit the ingredients shall be thoroughly agitated. As soon as the reaction commences, which with good chloride and steam of 45 to 50 pounds pressure is in about half an hour, the steam is stopped off, and the operative gives his chief attention to the condensing arrangement. The greater part of the chloroform comes over in the first ten minutes, but to get the last portion, half an hour is requisite. The workman stands at the exit tube, out of which a stream of distillate pours sufficient to fill a gallon bottle in less than a minute at first, and changes the bottles as fast as

they are filled. When the distillation subsides, steam is again let into the still until the last traces of chloroform and of undecomposed alcohol are driven over.

The crude chloroform, after repeated washing with water, is first re-distilled in a copper still of 150 gallons capacity, which separates from it a large quantity of black heavy oil, having an extremely suffocating odor. The distillate is then agitated with sulphuric acid in a large leaden revolving box, moved by steam; it is then drawn off, and on standing, until the acid separates, the chloroform is decanted into another vessel and agitated with strong liquor potassæ, again decanted after separating, and distilled a third time, rejecting about five per cent. of the last portion which is reserved for subsequent purification. The chloroform, thus obtained, will average in quantity thirty pounds of sp. gr. 1·495, and possess a degree of purity that fully fits it for medicinal use.

The merit of this still is its economy of labor, as one operative can manage it and work off five charges (2500 lbs.) of chloride in ten hours, which produces 150 pounds of purified chloroform, making the cost of labor for this part of the process less than a cent per pound.

Still for oil of cloves.—This is also constructed of boiler iron, cylindrical, about five feet high, and 3½ in diameter, and contains over 600 gallons. The dome-shaped top is surmounted by a leaden neck connected with an ordinary worm condenser; and is provided with a manhole for introducing the charge of cloves, which is about 350 pounds with 300 gallons of water. A square lateral opening exists near the base, which is closed by a clamp and screw pressing on an iron plate with a gum joint, the object of which is for conveniently removing the exhausted cloves, after the operation is concluded. The still is heated with pressure steam in a coil at the bottom. The distillate is received into a tall tinned vessel, of three gallons capacity, furnished with a funnel at top projecting down towards its centre, and from near the top, a lateral tube issues, bent upwards and then downwards so as to carry off the distilled water which collects above the oil. As the distilled water accumulates, it is returned into the still from time to time. About a day and a half are required to exhaust the charge with steam of an

average pressure of 45 lbs. The cloves are put in the still unground, which is found preferable to grinding them. The yield of oil is about 16 per cent. on the average, or nearly 60 lbs. from the charge of 350 pounds.

ON THE FLUID EXTRACT AND THE SYRUP OF IPECACUANHA.

By William Procter, Jr.

An alcoholic fluid extract of Ipecacuanha has been recommended by the Committee of the College of Pharmacy, as a means of making the syrup. This extract is made of the strength of an ounce to the fluid ounce by evaporating the tincture made with alcohol ·835 till reduced to the proper strength. This fluid extract contains the resin of the ipecacuanha, and its odorous fatty matter and wax, in part. When such fluid extract is employed to make the syrup by simply adding it to simple syrup, cold or hot, a cloudy syrup is obtained, which, while it is efficient and keeps well, separates by standing, and does not present a handsome appearance. With a view to remedy this objection, it is proposed to rid the fluid extract of all matter insoluble in cold water, so that when added to simple syrup, it shall produce a transparent medicated syrup.

The following formula is recommended:

Take of Ipecacuanha, in fine powder, 16 ounces, (troy,)
Alcohol,
Water, of each a sufficient quantity.

Mix the Ipecacuanha with six fluid ounces of alcohol, pack it firmly in a conical percolator, cover it with a disc of muslin, and pour on alcohol until three pints have nearly passed, or until the drug is exhausted. Distil off the alcohol from this tincture till a syrupy residue remains; throw this into a pint of water; boil it until the last traces of alcohol disappear, the liquid becomes nearly clear, and the waxy oleoresinous matter separates, and adheres to the vessel. When the solution cools filter it through paper, and if it does not measure eight fluid ounces, mix the residue with sufficient water to make that measure, but if it measure more evaporate it carefully to that bulk. To this add eight fluid ounces of alcohol, and mix.

Thus made, fluid extract of Ipecacuanha is a dark reddish brown liquid having the odor of Ipecacuanha, well marked, after standing awhile, and mixes with water and syrup to form a transparent solution. If the process is carefully conducted it fully represents the drug, as Pereira states that the waxy matter separated from the tincture is not possessed of emetic properties.

Syrup of Ipecacuanha.

Take of Fluid Extract of Ipecacuanha, a fluidounce,
Simple syrup, thirty-one fluidounces.
Mix them.

Thus prepared syrup of ipecac has a fine bright color, is transparent. and may be made without heat, and, in fact, extemporaneously. It may be well to mention that in the forthcoming Pharmacopœia it has been proposed to increase the strength of this preparation to ℥j to Oj, which is double the present strength, and equal to that of the wine. This will be a great improvement, and to make such syrup it will be simply necessary to mix a fluid ounce of this fluid extract, and fifteen fluid ounces of simple syrup.

ON MAGNOLIA GLAUCA.

By William D. Harrison.

(Extracted from an Inaugural Essay.)

This species of Magnolia is a small tree, usually from ten to thirty feet high in this latitude, and in the Southern States attains the height of forty feet. It is noticed in Massachusetts, but becomes more abundant in New Jersey and Maryland, and very abundant in Florida and Louisiana. It is called by the names, *Swamp Magnolia*, *Swamp Sassafras* and *Beaver Wood*. At the South, *White* or *Sweetbay*, is a name applied to it. It is confined chiefly to the tide water along the Atlantic coast.

The parts of the plant which have been used in medicine are the bark of the root, that of the trunk, and the fruit. The leaves are also medicinal.

The bark of the root is thick, tough, and spotted externally,

and smooth internally, of an aromatic odor and strong pungent, bitter taste, which is retained when the bark is dried.

The bark of the trunk is smooth, somewhat glaucous externally, and nearly white internally. When, recent, it has an aromatic odor and bitter taste, but by drying, these are entirely lost. *The leaves* are deep green above and glaucous beneath. When bruised they have a disagreeable odor and a pungent bitter and acrid taste, which are entirely lost by drying. The *flowers* are highly and very agreeably odorous, and perfume the atmosphere where they grow in abundance.

The fruit is conical, an inch to an inch and a half long, at first green, then of a pale red, composed of numerous cells, each opening externally by a fissure through which the deep red or scarlet seeds escape and hang by a filament. These are about the size of a pear. The kernels of the seed are extremely pungent and acrid to the taste, and irritate the throat when chewed.

CHEMICAL EXAMINATION.

This species of Magnolia appears to have attracted but little notice from chemists. The bark of Magnolia grandiflora was found by Dr. Stephen Procter to contain a crystalline principle analogous to the Liriodendrin of Prof. Emmet, in many of its properties.

Bark of the root.—An infusion was made in the proportion of an ounce to four fluid ounces of water. Its reaction was slightly acid, it was not precipitated by alcohol, very slightly by subacetate of lead, slightly by oxalate of ammonia, and not at all by nitrate of mercury or tincture of iodine.

When distilled with water, the recent bark affords an opalescent distillate from which a minute proportion of volatile oil separates on standing and floats upon the surface.

Half a pound of the dried bark was exhausted with alcohol .95 per cent., and when evaporated spontaneously afforded a hard brownish black extract, possessing a spicy odor and bitter, pungent, acrid taste, which caused a sense of burning in the throat when swallowed. This extract was treated (in the manner directed by Dr. Procter, (see vol. 14th, page 89, of this Journal) with a mixture of 1 part of liquor potassæ and sixteen

of water, until everything soluble in that menstruum was removed, leaving a tough tenacious mass of the appearance of putty. This was soluble in ether and alcohol, but insoluble in water. It was dissolved in alcohol and thrown on a filter. Before the liquid passed, the filter was lined with colorless transparent, very fragile crystals, which crack under the teeth, and when freed from adhering resinous matter have little taste or odor. The liquid which passed the filter, when evaporated spontaneously, afforded a greyish brown resinous extract, having the odor and taste of the bark in a high degree.

A tincture of the bark made with diluted alcohol is less pungent than that with strong alcohol.

An acetic tincture was aromatic and very bitter and pungent. An ethereal tincture, by evaporation, afforded no crystals, but consisted of resin, odorous matter, and fixed oil, which caused it to stain paper like oil. A small portion of aqueous liquid, strongly reddening litmus, remained after the ether had evaporated, the nature of which was not determined.

Bark of the trunk.—When an alcoholic tincture of this bark is allowed to evaporate spontaneously, a reddish brown extract is obtained, possessed of a bitter taste, and the odor of the bark but has very little pungency. It did not afford a crystalline matter as did the extract of the bark of the root, when treated by liquor potassæ, &c., the latter dissolving it and precipitating it on the addition of sulphuric acid. When this matter was dried and redissolved and evaporated, no evidence of crystals was obtained. Other processes were tried to isolate a crystalline matter like that in the root, but they all failed.

A decoction of the bark affords a dark green precipitate with sesquichloride of iron indicative of some analogue of tannin.

The *leaves*, also, when treated, did not yield the crystalline principle, but afforded a bitter extract, volatile oil and an undetermined acid.

The fruit.—The medicinal virtues of the Magnolia glauca appear to be concentrated in the fruit. The alcoholic tincture is very pungent and bitter, and of a light red color. By evaporation it yields a black, resinous, soft extract, associated with a thick liquid which is exceedingly pungent and acrid, affecting the throat when tasted, and creating a sense of nausea.

The resinous part of the extract when treated by dilute liquor potassæ, and afterwards by alcohol, did not afford the crystalline matter. The ethereal extract of the fruit contains much fixed oil associated with acrid soft resin.

All parts of this Magnolia are more pungent when recent than after drying, and preparations made from the bark or fruit, are best made from the recent plant. The results of Dr. Procter with the bark of Magnolia grandiflora show that that bark owes some of its virtues to volatile oil, and that this oil is found much more abundantly in the recent than in the dried bark. The experiments here detailed indicate that the Magnolia glauca has an analogous constitution, but seems much less strongly impregnated with the volatile oil and other active principles.

GLEANINGS FROM GERMAN JOURNALS.

By J. M. Maisch.

Solid oil of mint, pretending to have been imported into Hamburg from Japan, was examined by Gorup-Besanez, who found it to consist of the stearoptene of mint and of 13·66 per cent. sulphate of magnesia, which evidently had been intentionally added to impart a fine crystalline appearance to the product.—(Ann. der Chem. und Pharm. cxix. 245.)

To recognize grape sugar beside cane sugar.—O. Schmidt employs trisacetate of lead and ammonia, which produce with both sugars white precipitates, which after a while, particularly when heated, assumes a red color in the presence of grape sugar, but remains unaltered by cane sugar; a small quantity of the former mixed with a large proportion of the latter may thus be recognized by the red tint of the precipitate.—(Ann. der Chem. und Pharm. cxix. 102.)

Influence of silicic acid on fermentation.—J. C. Leuchs states that silicic acid precipitated from water glass, produces fermentation in saccharine solutions, particularly after the addition of some tartaric acid, and generates the odor of beer yeast, afterwards of fruits, and finally of ether; in very dilute

solutions the odor of putrid yeast appears. Silicic acid does not lose this property by boiling with water or by repeated employment for fermenting and subsequent washing with water. A solution of sugar, containing alcohol and tartaric acid, fermented briskly with silicic acid, from which the gas was evolved, and amid the separation of a yeasty foam.—(Portfolio.—Dingler's Polyt. Journ. clxi. 400.)

Amount of silver in photographs.—Dr. J. J. Pohl, of Vienna, has estimated the silver in positive photographs taken upon ordinary albuminated paper; after drying them, at 100° C. (212° F.) he found 0·116 per cent. equivalent to 0·125 per cent. oxide and 0·183 per cent. nitrate of silver. The value of the material is, therefore, very insignificant.—(Zeitschr. f. Photogr. 1861, 139.)

Analysis of carbonates and black oxide of manganium.—Prof. H. Kolbe evolves the carbonic acid from a flask, dries it by passing it over cotton and chloride of calcium, and absorbs it in a Liebig's potassa-apparatus. After thus determining the carbonate of lime in the manganese, an excess of oxalic acid is introduced into the flask and heat applied; from the amount of carbonic acid now absorbed by the potassa, the amount of available binoxide of manganese is readily calculated.—(Ann. der Chem. und Pharm. cxix. 130.)

Splitting of atropia.—Prof. Ludwig and Pfeiffer endeavored, without success, to decompose this alkaloid by boiling with dilute sulphuric acid similar to solania, (Zwenger and Kindt), but on boiling it with chromate of potassa and dilute sulphuric acid, the liquid when of a certain concentration, turns green, needles of benzoic acid are sublimed, and the aqueous vapors excite to coughing from their contaminations with the same acid. The green residue when supersaturated with caustic potassa, generates alkaline vapors of propylamin, possessing the odor of herring pickle. The decomposition probably takes place in accordance with the following formula:—

$C_{34}\ H_{23}\ NO_6 + be = C_{14}\ H_8\ O_2 + C_{14}\ H_6\ O_4 + C_6\ H_9\ N$.

Atropia = benzoic alcohol + benzoic acid propylamin.

(Archiv der Pharm. cvii. 131–132.)

Acids of Benzoin.—Hermann Aschoff obtained from Benzoin of Sumatra pure cinnamic acid, without finding benzoic acid; the white tears were entirely soluble in ether and contained 11·2 per cent. cinnamic acid. A second quality of Sumatra benzoin and several kinds from Siam did not contain a trace of cinnamic acid. He recommends the following ways for detecting cinnamic acid in the balsam; it is either boiled with milk of lime, the filtrate decomposed by muriatic acid and treated with bichromate of potassa and sulphuric acid, or with permanganate of potassa; or the alcoholic tincture is poured into water, the alcohol evaporated and the filtrate treated in the same way. The presence of cinnamic acid is manifested by the odor of oil of bitter almonds. Benzoin containing cinnamic acid is unfit for preparing benzoic acid for medicinal purposes.—(Archiv d. Ph. cvii. 153–157.) Kolbe and Lautemann obtained from Sumatra benzoin a mixture of 2 equiv. benzoic with 1 equiv. cinnamic acid, fusing at 94° C.—(Annal. der Chem. und Ph. cxix. 186.

An analysis of Anachuita wood is published in Archiv d. Pharm. cvii. 176–179. By repeated fractional cohobation and agitation with ether, an oily liquid was obtained, possessing the odor of the wood; it was an aldehyde. The decoction was precipitated by acetate and subacetate of lead, which precipitated a tannin resembling that of catechu, gallic acid and a little arabin. The sulphide of lead obtained on decomposing these precipitates, contained some products of oxidation and a little yellowish resin. The filtrate after removing the lead, evaporating and treating with alcohol, separated uncrystallizable sugar and a gummy organic lime salt; more alcohol removed a pectinate. The filtrate evaporated and treated with ether, separated grape sugar, and the filtrate left on evaporation groups of sublimable warty crystals, and a thick liquid which, on evaporating spontaneously over sulphuric acid, left white needles, soluble in alcohol, somewhat less in ether and water, more freely in alkalies; they are the bitter principle, but are destitute of alkaline properties.

The thus exhausted wood yielded nothing of interest besides an acid and neutral resin, to acidulated and alkaline water,

alcohol and ether. The wood left 4·5 to 5 per cent. ashes consisting of carbonate of lime with little chloride of magnesium and sulphate of lime.

Protosulphate of manganium, free from iron, is prepared by Delffs, by treating black oxide of manganium with washed sulphurous acid gas, which does not take up a trace of iron. Other bases besides iron must be removed by treating previously with dilute nitric acid.—(Zeitschr. f. Ch. und Pharm. iii.)

Aspidine is the name given by Pavesi, of Mortara, to the following preparation containing the active principle of the root of male fern. 1 kilogr. of recently dried powdered root is displaced by alcohol and then by water; the two liquids are mixed, the alcohol distilled off and the residue boiled for a few minutes with 75 grm. slacked lime. After 24 hours rest, the precipitate is washed with water, dried and exhausted by boiling alcohol; the solvent is evaporated when an oleo-resinous substance is left possessing an acrid bitter and nauseous taste. It may be given in pills or in alcoholic and ethereal solution.—(Giorn. di. farmac. c di chim. di Torino.—Archiv d. Ph. cvii. 231.)

Borax in milk.—Prof. Kletzinsky states that borax is often employed to prevent milk from turning sour and to impart to it more consistence so as to make it appear more cream-like. This addition is detected in the ashes by boiling them with alcohol acidulated with sulphuric acid; the presence of boracic acid is ascertained from the brown color of curcuma paper and from the green flame of the burning alcohol.—(Polyt. Centr. bl. 1861, 224.)

Detection of paraffine in wax.—Prof. Landolt, of Bonn, recommends to warm the wax with an excess of fuming sulphuric acid, (Nordhausen oil of vitriol;) a complete destruction of the wax takes place, leaving a black gelatinous residue; paraffine is under the same circumstances very slowly attacked and remains as a transparent layer, readily separated from the fluid portion. Wax containing 50 and 75 per cent. paraffine, yielded 45 and 68 per cent.—(Schweiz. Zeitschr. f. Ph. vi. 170–171.)

Test for gaseous sulphurous acid.—Hugo Schiff employs paper moistened with solution of protonitrate of mercury which instantly assumes a gray color from reduced mercury; it is requisite to test with lead paper for sulphuretted hydrogen. Both gases are not present at the same time, as they decompose each other.—(Dingler's Journ. 1861, May.)

Paraguay tea.—Dr. Stahlschmidt found that the distillate from Paraguay tea was opalescent, had a peculiar slight odor of tea and a taste resembling peppermint. From 18 lbs. he obtained 38 grm. caffeina = ·44 per cent. or more than three times as much as Stenhouse, by the following process:—The decoction was precipitated by basic acetate of lead, the decanted liquid freed from lead by sulphuretted hydrogen, evaporated and the syrupy residue treated with hot benzole. On cooling, caffeina crystallizes in white needles, nearly chemically pure, which may be re-crystallized from water or alcohol.—(Poggendorf's Annalen, cxii. 441.)

Extractum gentianæ.—Considering the presence of pectin and pectase in gentian root, and the conversion of the former by the latter under the aid of a moderate heat into nearly insoluble pectic acid, Feldhaus urges the propriety of exhausting the root by digesting it for several days at a temperature of 45° C. (113° F.) On expressing the aqueous liquid, floccules of the acid remain behind intermixed with the ligneous portion of the root. The infusion is now evaporated to about ¾ the weight of the root employed and mixed with an equal bulk of strong alcohol, and may now be easily strained; the residue is washed with 45 per cent. alcohol, strongly expressed and is then almost inert and but slightly bitter. The alcohol is regained by distillation and the extract left on evaporation (4½ lbs. from 20 lbs. root) is rapidly and completely soluble in water, separating but few floccules on standing. Thus prepared very little pectin remains in the extract, it not being completely insoluble in diluted alcohol; but aside from the rapid solubility, the extract has no pasty consistence and is not liable to mould. The same process is applicable to other extracts.—(Archiv d. Ph. cvii. 294–298.

Castor.—Dr. F. G. Geiss reports that the beaver is still found

in the neighborhood of Aken, on the Elbe, Germany, and that he has found the following method best for the preparation of castor: The sacs are carefully removed from the recently killed beaver, and freed from all adhering fat; the open end is loosely tied, and the sacs then subjected to moderate and gradually increased pressure to expel gases. As soon as the membranes adhere closely to the contents, they are repeatedly painted over with wood vinegar, and the weights are afterwards removed. Any gas still contained in the bag is expelled by puncturing the place with a pin; the bags are again pressed for 24 hours, the punctures are closed by a little collodium, and the whole left to dry in the open air, which is accomplished in from one to two weeks. The loss in weight is about one-fourth of the original. The complete expulsion of the gas is necessary to prevent partial decomposition. Only the full grown male beaver yields a hard and rapidly drying castor; that of the female is softer, more difficult to dry and notwithstanding all precautions, remains soft in some places.—(Archiv der Pharm. cvii. 306–308.)

A red coloring matter from Sorghum saccharatum, called Baden red, is prepared, by A. Winter, by fermenting the cut and expressed stems, piled up under a shed to the height of several feet, and avoiding too high a heat by regulating the draught of air. The mass will have turned red or reddish-brown in about two weeks, is now dried, ground and macerated in cold water. The expressed mass is then treated with a weak potassa or soda lye, the liquor neutralized by sulphuric acid, and the red flocculent precipitate collected upon a filter, washed and dried. The coloring matter is readily soluble in alcohol, alkalies and diluted acids, and is printed upon silk and woollen fabrics by means of the ordinary tin mordants; the colors thus produced are not affected either by sunlight, or washing with soap. It is stated that the preparation of this dye has been long known and extensively used in China.—(Allg. Deutsch. Telegraph.)

Tima, a new remedy for consumption, comes from Tampico, Mexico, and is used in the form of syrup, prepared by boiling

the fruit, together with the seeds of Crescentia edulis, Derv., with sugar, and adding a little oil of almonds. Professor Walz analyzed the fruit, and found butyric, acetic, tartaric and malic acids, resin, sugar, gum, pectin, humin and lignine; the ashes contain potassa, soda, little lime, phosphoric acid, magnesia, alumina.—(N. Jahrb. d. Ph. xv. 426.)

Laudanum liquidum Sydenhami.—L. Lade, of Geneva, has made some interesting experiments to ascertain the best menstruum for this preparation. He employed Malaga wine of 1·040 spec. grav. which left 17 per cent. extract; Swiss (Waadtland) wine of ·995 spec. gr. containing 1½ per cent. extract, and alcohol of ·931 leaving no residue. Of the saffron, cinnamon and cloves, Malaga wine dissolved 48, Swiss wine 54, and diluted alcohol 59 per cent.; these tinctures macerated with opium took up 60, 66 and 70 per cent. and increased in spec. grav. ·031, ·034 and ·039 respectively. The amount of extract remaining on evaporation of these three tinctures was 23, 10, 10 per cent., from which, however, the solid ingredients of the menstrua must be deducted, so that Malaga wine has taken up 6, Swiss wine 8·5, and diluted alcohol 10 per cent. of its own weight. These experiments prove the superiority of diluted alcohol over Malaga wine, the solvent power of which appears to be materially impaired by containing 17 per cent. (℥iv. per ounce) of sugar, extractive and salts.—(Schweiz. Zeit. f. Ph. vi. 157–160.)

Sticky plasters.—The Schweiz. Zeitschr. f. Ph. vi. 169, recommends to sprinkle the plaster board, after the moisture has evaporated with lycopodium, and after rolling, the plaster may be kept without adhering to the paper. Freshly spread plasters, particularly in summer, or when to be carried a great distance, are prevented from adhering by lycopodium, which, previous to their application, is wiped off. Small quantities of turpentine, liquid storax, &c., for mixtures or pills, are best weighed out upon paper sprinkled with lycopodium, which prevents them from adhering.—(Schweiz. Zeitschr. f. Pharm. vi. 169.)

ON THE SOLUBILITY OF CREAM OF TARTAR IN ACIDS AND ITS PURIFICATION FROM LIME BY MURIATIC ACID.

By Dr. Tenner, of Bern.

It was proposed by Wittstein and adopted by the Prussian Pharmacopœia to digest for 24 hours in a water-bath ten parts finely-powdered cream of tartar, with the same quantity of water and one part of concentrated muriatic acid. If well washed, the greatest part of the lime is removed. On evaporating the acid liquid, and cooling, a gelatinous mass is obtained, but faintly smelling of muriatic acid, and consisting of a mixture of crystals of bitartrate of potassa, chloride of potassium, chloride of calcium, muriatic and tartaric acids. To ascertain the reaction, the behaviour of the neutral tartrate of lime and of pure cream of tartar to muriatic acid was observed.

Tartrate of lime was prepared by precipitating neutral tartrate of potassa with chloride of calcium. Two ounces of this limesalt were digested for several hours at a temperature of about 44° C. (111° F.) in a mixure of ½ ounce muriatic acid sp. grav. 1.1644 and 7½ oz. water; solution took place rapidly and completely. After standing two days at ordinary temperature the precipitate was collected, washed and dried; it weighed 11 drachms 14 grs., and 286 grs. were consequently dissolved. Half an ounce of muriatic acid of 1.1644 sp. gr. contains 33.3 per ct. anhydrous HCl, or 80 grs.; tartrate of lime is therefore dissolved with complete decomposition and the formation of chloride of calcium; for

$$72.92\ HCl : 260,\ 2CaO,C_8\ H_4\ O_{10} = 80 : 285.$$

This behaviour suggested the idea that the increased solubility of cream of tartar in some acids was owing to its decomposition amid the production of the corresponding potassa salts. The following experiments were then made: Pure cream of tartar in excess was treated with diluted acids and with the potassa salts of the same. Starting with muriatic acid, which contained 80 grs. HCl in 8 oz., the acids and salts were employed of such strength as to correspond by their equivalent weight with the muriatic acid. They were all digested for 24 hours at about 41° C. with frequent agitation, and then exposed for

48 hours to the common temperature of about 20° C. The residue was now collected, washed with very little water, and the dissolved portion ascertained from the loss. The results were as follows:—

	Mixture.	Dissolved Cream of Tartar.	Proportion.
1.	8 oz. water.	28·50 grains.	1: 135
2.	" " and 330 grs. $\bar{T}$	36·75 "	1: 104
3.	" " " 80 " HCl	274· "	1: 14
4.	" " " 163 " KCl	4·75 "	1: 808
5.	" " " 119 " NO_5	307·50 "	1: 12
6.	" " " 222 " KO NO_5	6·75 "	1: 568
7.	" " " 88 " SO_3	225· "	1: 17
8.	" " " 191 " KO SO_3	7·25 "	1: 530
9.	" " " 132 " $\bar{A}c$	30·75 "	1: 124
10.	" " " 216 " KO, $\bar{A}c$	55·50 "	1: 69

If cream of tartar was as readily decomposed by hydrochloric acid as tartrate of lime, there ought to have been dissolved in experiment No. 3 at least 412 grains; but here, as well as in Nos. 5 and 7, the decomposition is incomplete. Tartaric and acetic acids increase the solubility but little, while chloride of potassium and nitrate and sulphate of potassa decrease it considerably. Acetate of potassa is decomposed by the bitartrate on digestion; the liberated acetic acid appears to be partly recombined on cooling.

There are three points to be observed in the purification of cream of tartar from lime by muriatic acid: 1. Action of the dilute muriatic acid upon all particles of the cream of tartar. 2. Complete removal of the acid liquid; and 3. Employment of sufficient muriatic acid.

Duflos' original direction to treat the crystals of cream of tartar with the dilute acid, will perhaps never accomplish the entire separation of the lime; the finer it has been powdered, the better will its purification be effected; but it was impossible to obtain the preparation free from lime; by following the directions of the Prussian Pharmacopœia, it will, however, be sufficiently pure for all pharmaceutical purposes.

The acid is best removed, by stirring the mixture repeatedly in water and decanting; the proportion of lime remaining be-

hind is very small, if the washing is effected immediately after digestion; if the mixture is set aside for 24 hours, it will be mixed with crystals of bitartrate of potassa containing lime, which cannot be purified by washing.

Cream of tartar is obtained entirely free from lime, if the acid mixture is completely dissolved in warm water, and the solution then evaporated with constant stirring until it has double the weight of the salt employed, when it is to be rapidly washed out.

The requisite quantity of muriatic acid depends on the amount of lime present; the more of it is employed, the easier will be the removal of the latter, but the greater likewise the loss of cream of tartar; for experiment 3 shows that ½ oz. of concentrated muriatic acid will dissolve 274 grs., or somewhat more than its own weight. A quantity of muriatic acid somewhat larger than just sufficient for the decomposition of the limesalt, will probably suffice in all cases. When evaporating with larger quantities, it is for this reason advisable to make an estimation of the lime and calculate the necessary quantity of muriatic acid, 1 part of which, to 10 of cream of tartar, will, in most instances, be more than sufficient. 100 carbonate of lime are equivalent to 260 tartrate of lime, and to 70.8 HCl or 212.4 muriatic acid sp. gr. 1.164 of 33.3 per cent.

The use of thus purified cream of tartar in preparing tartrate of potassa, or of potassa and soda, &c., has the advantage that less water is necessary, that the crystallization is not disturbed by the subsiding pulverulent tartrate of lime, and that the iron and other coloring matters have been completely removed by the muriatic acid; the loss of cream of tartar is thus compensated for.

14lb cream of tartar, containing 8·8 per ct. or nearly 1¼lb tartrate of lime, yielded by the process of the Prussian Pharmacopœia 12lb pure cream of tartar, showing a loss of ¾lb, or 5.5 per ct., and gave 17½lb clear Rochelle salt. Of cream of tartar containing lime, 4 parts yield usually 4½, rarely 5 parts of this double salt; the above 14lb would consequently have furnished 15.8lb to 17.5lb, or, under the most favorable conditions, not more than in this instance.

If the acid liquid is precipitated by milk of lime, the tartrate of lime will usually have a yellowish color due to iron, which renders it unfit for the preparation of tartaric acid. Even if the acid is not entirely neutralized, the precipitate contains a portion of it. For complete saturation, a little more of burned lime than one-fourth the weight of muriatic acid will be necessary.

The cream of tartar free from lime, with which commerce is supplied from Würtemberg, does not yield such purely white preparations as that obtained by the above process; but it is well adapted for the tartrate of iron and potassa.—*Schweiz. Zeitschr. f. Ph.* vi. 160–65. J. M. M.

ON THE PREPARATION OF CHLOROFORM.

By B. Hirsch, of Gruenberg.

M. Pettenkofer's paper on the same subject (see Amer. Journ. Ph., 1861,) has induced the author to publish his observations, made during the years 1852—54, in Berlin, under the direction of Wittstock. The chloride of lime was passed through a wire sieve to break up all lumps, and immediately mixed with sufficient cold water to produce a thin past, which was poured into a still, and water added to make its quantity four times that of the chlorinated lime. Alcohol of 90 per ct., Tralles (sp. gr. 834,) amounting to from 17½ to 20 per ct. of the chlorinated lime, or a corresponding quantity of weaker spirit, deducting at the same time the equivalent weight of water, is carefully stirred into the mixture, the head is luted on and connected with a refrigerator. Not more than two-thirds of the still must be filled by the whole mixture, so as to give room for the rising of it during the reaction. A moderate fire is at once applied, and the temperature in the still allowed to rise to 34 or 36° R. (108.5 to 113° F.), when all the fire is immediately withdrawn. The proper temperature depends on the quantity of the material, on their relative proportions, on the shape and size of the still, but principally in an inversed proportion on the strength of the hypochlorite of lime, which for this reason must previously be carefully ascertained, and, finally, on the length of time necessary

to heat the mixture to a certain degree. The slower it is heated, the lower ought the temperature to be; when heated rapidly, it may become a few degrees hotter without any disadvantage. After the removal of the fire, the temperature usually sinks to 102 or 104° F., remains stationary for about half an hour, and then commences to rise again; this rise of temperature is higher, the less and the slower it had previously decreased. The highest degree attained in about 96 operations between 62 and 74° R. (171.5 and 198.5° F.) If the thermometer has fallen to below 30° R. (100° F.) the reaction will not commence for several hours, and it is preferable to heat the mixture a few degrees higher.

When the temperature has risen to 122° F., chloroform begins to pass over, and with the constant and rapid rise of the thermometer, the distillate soon runs in a continuous stream. After the highest heat has been reached, the last portions of chloroform are carefully distilled by a moderate heat, and finally the remainder of the alcohol, which is detained by the chloride of calcium with a certain force so that the theremometer reaches 213 to 214° F., before the last portions are expelled. If now a second distillation is undertaken, the fire ought to be slower than with the first one, because the still and its surroundings are still warm. The weak spirit obtained by distillation, and by washing the chloroform, is, after ascertaining its strength, used for the second operation. An increase of the alcohol over 17½ per ct. was never accompanied with an increase of the yield; indeed, 100 lb. chloride of lime, containing 30 per ct. active chlorine, require of the above alcohol but 3.178 lb., according to the following formula: $2(C_4H_6O_2)+8(Ca\,Cl+Ca\,O,+ClO)=C_2HCl_3+3(Ca\,O+C_2HO_3)+13\,Ca\,Cl+8HO$. Practically, 5½ to 6 lb. alcohol were used, but the author recommends not to decrease the quantity below 15 or 17½ per ct. as it is preferable to have some alcohol in excess, than to lose chlorine uncombined.

The chloroform obtained as above, is freed from the spirituous portion, by a separating funnel and now contains chiefly some alcohol as impurity, which is removed by repeated washing with water; when agitated with an equal volume, its first loss is about 15, the second time 6 or 7, the third time about 3 per ct. by

volume; on shaking it a fourth time with water, the loss is very small, and the specific gravity of the chloroform is now 1.498 to 1.499, and was once obtained as high as 1.501. The loss by weight of the crude chloroform, equivalent to 25 per ct. by measure is only about 12 or 13 per ct., because water removes chiefly the alcohol. The wash waters contain a variable quantity of chloroform, held in solution by alcohol, and obtainable by distillation and washing. The product now contains a small proportion of water and alcohol, and some heavy chloric ether,* the latter of which is probably the cause of the coloration of chloroform by sulphuric acid. To free it from these impurities, the chloroform is agitated with about 5 per ct. of dry chloride of calcium, decanted into a dry retort and rectified in the water-bath, the temperature of which ought to be preserved at 56° R. (158° F.), when 98 per ct. are obtained in a perfectly pure state, so that sulphuric acid has no effect even after a contact for several days. If the distillation is then continued with a higher heat, a single drop of the distillate will color several drachms of sulphuric acid dark-brown, which proves the correct separation by this method. A black inodorous liquid remains in the retort, which from 50 ℔. chloroform, varies from a few drops to two ounces in amount. The chloride of calcium will yield when distilled with water, a little impure chloroform which may be preserved for subsequent purification.

The author then gives the results of a series of 18 distillations, 17 of which were made with the following quantities: 40 ℔. chlorinated lime of 30 per ct. chlorine, 7 ℔. alcohol of 90 per ct., 160 ℔. water. This mixture was heated to a temperature between 32° and 37° R. (104 and 115° F.); in each case, the time was carefully noted in which the thermometer fell to its lowest point, also the temperature to which the mixture rose spontaneously, the quantity of crude chloroform obtained, and the loss by volume on agitating with an equal bulk of water. The following comprises the entire result of three series:

* This heavy chloric ether which was formerly officinal in many European Pharmacopœias, under the names of Aether (s. Naphtha) chloratus, s. chloricu, s s.bichloricus, is, according to Schloosberger, a mixture of chloral, aldehyde, acetic ether, &c. Hager prepares it by distilling a mixture of 1 p. chlorinated lime, 5 water, and 1 alcohol.

715 lb. chlorinated lime of 30 per ct., = 214.5 lb. active chlorine yielded 50 17–32 lb. washed chloroform = 23.557 per ct. of the chlorine; alcohol used 48¾ lb.

605 lb. chlorinated lime of 32.6 per ct. = 197.23 lb. chlorine yielded 44 13–16 lb. = 22.721 per ct. of the chlorine; alcohol used 42 3–16 lb.

732 lb. chlorinated lime of 29 per ct. = 212.28 lb. chlorine yielded 48¼ lb. = 22.729 per ct. of the chlorine; alcohol used 40¾ lb.

The appearance of chlorine vapors, the author believes to be caused by overheating; he has never met with them. When steam is employed, it is suggested to keep the mixture at a temperature near 32° R. (104° F.) until it commences to rise spontaneously. To pass the steam directly into the still is not advisable, except for driving over the last portions of alcohol and chloroform. Alcohol free from fusel oil, is not deemed requisite, inasmuch as ordinary crude spirit gave a product quite as good. If operating with the above precautions, the employment of carbonate of soda for washing is entirely unnecessary; but a single washing with water is insufficient; it is recommended to repeat it four times. It is to be presumed that Pettenkofer's chloroform, of which the specific gravity has not been stated, would lose by repeated washing at least 6 per ct., so that the most favorable yield would be reduced to 6.58 per ct. Of 2052 lb. chlorinated lime of 30·5 per ct., the author obtained 143.6 lb. = 7 per ct. chloroform well washed and of spec. grav. = 1.499. It is more instructive to compare the yield with the available chlorine.—(*Archiv. d. Pharm.* cvii. 137—153.) J. M. M.

ETHER FORMED BY FERMENTATION.

Leuchs says (Chem. centralb., No. 25, 1861,) that raisins from which the greater part of the sugar has been extracted by boiling, made into balls, laid under a glass bell, and kept at 64° F. form ether, which is also produced when cotton wool, moistened with a mixture of sugar, spirit of wine and water is placed under the same circumstances, and that ether is always found when these bodies are at the same time present in porous bodies.

DESCRIPTION OF A GAS FURNACE FOR GENERAL CHEMICAL USE.

By John Joseph Griffin, F. C. S.

Fig. 2.

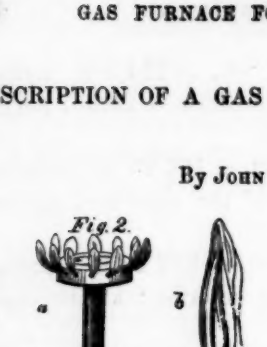


Fig. 3.

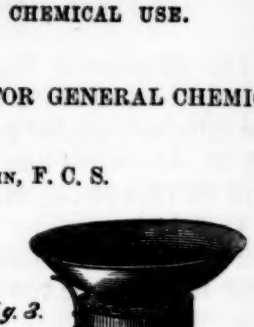
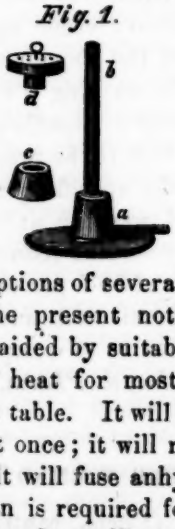


Fig. 4.

Fig. 1.



I have already published descriptions of several gas furnaces, adapted to special purposes. The present notice refers to a simple form of gas-burner, which, aided by suitable fittings, can be used as a convenient source of heat for most operations of the chemical laboratory and lecture table. It will boil a quantity of liquid, exceeding two gallons at once; it will raise a 4¾ inch fire-clay crucible to full redness; it will fuse anhydrous carbonate of soda in greater quantity than is required for the analysis of a siliceous mineral; and it will melt small quantities of sterling silver. This amount of power is sufficient for most chemical operations that are not metallurgic.

The Gas Burner.—Fig. 1 represents the gas burner of this apparatus. The gas is supplied by the horizontal tube, whence it passes through a set of small holes into the box *a*, in which it mixes with atmospheric air that enters freely by the holes shown

in the sketch. The gaseous mixture passes up the vertical tube *b*, and is inflamed at the top, where it burns with a single, tall, blue flame, which gives no smoke, very little light, but much heat. In this condition, the apparatus differs from "Bunsen's Gas-burner" only in size. *c* represents a thin brass cap, which fits the air-box *a*, but moves easily round it. *d* is a flat, cast-iron box, with many holes round the margin, and a few small ones on the top. This box fits loosely on the upper part of the tube *b*, and when it is placed upon it, and the gas is lighted, the flame produced consists of a series of radiating jets, forming a horizontal circular flame of about 7 inches in diameter. Fig. 2—*a* shows a ring of horizontal flames thus produced, and *b* shows the single vertical flame.* The ring of flame is suited to the purposes of boiling and evaporation; the single flame to ignition and fusion. The height of the apparatus represented by Fig. 1 is 12 inches; the bore of the tube *b* is 1 inch; and the diameter of the fire-box *d* is 4 inches.

Bunsen's gas-burner, whatever its size, is subject to two defects: sometimes the flame burns white and smoky, and sometimes it blows down, the gaseous mixture explodes, and the gas then burns with a smoky flame in the air-box *a*, Fig. 1. The remedies for these defects are as follows:—If the flame is white only when the gas is turned on very full, the remedy is to lessen the supply of gas; but if the flame continues to burn white at the top when the gas is gradually turned off, and the mass of flame slowly sinks, then the holes which deliver the gas from the supply pipe into the air-box are too large, and are placed too directly under the centre of the vertical tube *b*, Fig. 1, and these defects must be corrected in the instrument. Finally, when the flame blows down, it is because the supply of atmospheric air is too large in proportion to the supply of gas, and their relative proportions must be altered. To effect this alteration, the cap *c* is to be turned round on the air-box *a*, so as partially to close the holes, and thus lessen the supply of air. If, when the gas is alight, the flame needs to be lowered, first the supply of air is to be lessened, and then the supply of gas. If the flame is to be enlarged, first the supply of gas must be

* Fig. 2 represents a small variety of this gas-burner, in which the head is not removable, but the efflux of the mixed gases is regulated by a sliding valve, which is represented by *b*.

increased, and then the supply of air. In short, to prevent the flame blowing down, the gas must always be first placed in excess, and then have the proper quantity of air adjusted to suit it by means of the regulator *c*.

Arrangement for Boiling and Evaporation.—Fig. 3 represents this gas furnace arranged for boiling and evaporation. *a* is the gas-burner, Fig. 1; *b*, an iron stool with three legs; *c*, a furnace body, or iron jacket, lined with plumbago or fire-clay. Fig. 4 shows the jacket and lining in section, and marks the position of the fire-box, *d*, of the gas-burner. This furnace is 14 inches high, and 9 inches in diameter. The three brackets fixed on the upper part of the jacket serve to support the vessel that contains the liquid that is to be boiled or evaporated. A porcelain basin of 16 or 18 inches in diameter can be thus supported. It is important to allow between the jacket *c* and the evaporating basin plenty of space for the escape of heated air, which ascends from the interior of the furnace. When the evaporating basin is of small diameter, it may be supported on iron triangles, placed in the furnace *c*. Fig. 4 shows that, around the vertical tube of the gas-burner, *a*, there is in the bottom of the furnace, *c*, a circular opening, which is of 2 inches diameter, and through which air passes freely, partly to feed the flame and partly to be heated by the flame, and be directed upwards in a continuous current upon the lower surface of the basin that is to be heated. The flame within the furnace burns steadily. No side currents of air agitate it. No part of it touches, or must be permitted to touch, the basin, which should receive its heat solely from the mass of ascending hot air. The gas-burner thus arranged, and supplied by a gas-pipe of $\frac{1}{4}$ inch bore, burns about 33 cubic feet of gas in an hour, and the flame which it produces, acting upon water contained in an open porcelain evaporating basin, will heat from 60° to 212° F.,—

1 quart in 5 minutes.
1 gallon in 15 "
2 gallons in 30 "

and when the water boils it is driven off in steam at the rate of more than a gallon of water per hour. The method is consequently applicable to distillation on a small scale, and to numerous operations in pharmacy.—*Chem. News, London, Nov.* 2, 1861.

ON THE ORIGIN AND PROGRESS OF THE PHOSPHORUS AND MATCH MANUFACTURES.

By G. Gore.

It has been wisely remarked, that Science "teaches us to be neglectful of nothing; not to despise small beginnings, for they precede, of necessity, all great things in the knowledge of science, either pure or applied." Not only should we not neglect scientific knowledge, but we should nurse as it were the smallest scientific truth; trying and watching the influence of various conditions upon it: increasing its distinctness or importance by modifying the surrounding circumstances: adding here a little and there a little, in order to magnify the extent or variety of its applications to human benefit. It is by such processes of treatment as this, slow and certain, that the little facts of the bygone alchemists, and of the more modern scientific investigators, have been extended and elaborated into the marvellous and magnificent realities of the present day.

Nearly all the great practical results of science of this period have had their origin in apparently useless and out-of-the-way observations. The expansive power of steam was known long before it was applied to any useful purpose. One observed and and another observed the influence of various circumstances upon it; one invented and another contrived additional means of controlling it and directing it: one added and another introduced contrivances and pieces of accessory mechanism to increase its power, until from the simple and apparently useless fact of vapor expansion, it has grown to be the giant power of the earth, influencing the action and habits of nearly all mankind.

The curious facts respecting the action of liquids on metals, observed by Volta and Galvani, and the action of electric currents on magnets, have, by the repeated trials and applications of subsequent discoverers and inventors, been elaborated into the present system of electro-telegraphy, which bids fair to cover the whole earth with its wires, and to bring every human being into speaking distance with each other.

No reasonable and intelligent person can compare the com-

mencement of these things with their present developments without being impressed with the insignificance of their origin and the magnificence of their practical results, nor without being convinced of the importance of abstract scientific investigation. It is not my object on the present occasion to dilate upon the relations of abstract science to manufactures and practical life, but to give some account of the origin, progress, and present condition of the phosphorus and match manufacture.

In the year 1669 phosphorus was accidentally discovered in human urine as "a dark, unctuous, daubing mass," by Brandt, a merchant and alchemist, of Hamburg, while searching for a liquid capable of transmuting silver into gold. By some means it appears that at the same time Kunckell, a German chemist, gained some knowledge of the means of obtaining this substance, and communicated it to Kraft, of Dresden, who proceeded to Hamburg, and paid 200 dollars for a specimen "for him to make demonstrances to princes." Kunckell prepared some of the substance and exibited it to the Courts of Saxony and Brandenburg, although it was not a very delicate or agreeable exhibition, "because the unctuous and daubing oilyness was not yet accurately separated from it, and, without doubt, it was very stinking, and therefore unpleasant." He also gave some to his friends, Professors in Germany, and to Mr. Link, of Leipsic, for sale. An account of it was published in his "Laboratorium Chymicum," Hamburg and Leipsic, 1716, p 660.

To afford some idea of the effect of Brandt's discovery upon his fellow-townsmen and upon alchemists generally, I quote the following:—"When, now, such like noble motives made that good old man Brandt to broil and to sweat much more by his excrements, one may easily guess how much at that time the whole heaven of Hamburg did hang full of fiddles as he brought forth out of it a lumen which, in the world, is counted the most perfect *agens intrinsicum*. There was then cried nothing but triumph and victory among the chymists. Those good people erected already in their thoughts so many hospitals and poor-houses that no beggar should ever more molest any man in the streets, made great legacies, and pious causes, and what not else. Besides, the other alchymists did encourage him yet more, and desisted not to make him believe how this was that same

fiery ghost of Moses that in the beginning moved upon the water, yea, his splendid shining face: the fiery pillar in the desert, that secret fire of the altar wherewith Moses burned the golden calf before he strewed it upon the fire and made it potable."

About the year 1670 the Honorable Robert Boyle, an Irishman and a philosopher of this country, brought over from Germany a youth named Ambrose Godfrey Hanckwitz to assist him in his chemical experiments, and having obtained information from Saxony of the method of extracting phosphorus, directed his assistant, Mr. Bilger, to instruct Hanckwitz to prepare some of it. Hanckwitz it appears succeeeded in preparing an ounce of the substance and presented it to his master even before he received the instructions from Mr. Bilger. He was now sent by Boyle on a tour through "Holland, Italy, Naples, and Germany," to gain further information respecting "the marvellous lumen," but with little success, for he returned without meeting with "even one that could make even that poor daubing stuff as Kunckell's out of the usual microcosmical matters."

In No. 135 of the *Philosophical Transactions* of the Royal Society, dated March 26, 1677, page 87, is a paper by Boyle, entitled, "An Account of Four Sorts of Factitious Shining Substances, communicated to the publisher from very good hands, both in printed papers and in letters not printed." After speaking of three sorts, it says:—"The other is Phosphorus Fulgurans, which is a matter made both in a liquid, and dry form, and not only shineth in the dark and communicates a sudden light to such bodies as 'tis rubbed upon, but being included in a glass vessel, well closed, doth now and then fulgurate, and sometimes also raise itself, as 'twere, into waves of light. Differing from the Baulduinian stone which is to be exposed to some shining body, as the day, the sun, the fire, or some lighted candle, to receive light from these, whereas this fulgurating substance carries its light always with it, and when put in a dark place presently shows the same. Of which we have this further assurance given us, that a little portion of it having been kept two whole years hath not yet lost its power of shining. So that 'tis believed that if a considerable big piece was prepared of it, it would serve for a perpetual, or, at least, a very long lasting light."

In No. 150 (August 10, 1683), p. 289, is also given "An Account of some Experiments made at several meetings of the Royal Society by the ingenious Frederick Slare, M.D., F.R.S., and one of the the Royal College of Physicians, with some short applications of them to physical matters." He gives "A Parallel between Lightning and a Phosphorus," and relates a number of experiments of adding phosphorus to oil of vitriol, water, oil of turpentine, and oil of petroleum, producing combustion, &c. &c.

And in No. 196, p. 579, dated January, 169⅔, is "A paper of the Honorable Robert Boyle's, deposited with the Secretaries of the Royal Society, October 14, 1680, and opened since his death, being an account of his making phosphorus, &c." "September 30, 1680. There was taken a considerable quantity of man's urine (because the liquor yields but a small proportion of the desired quintessence), of this a good part at least had been for a pretty while digested before it was used. Then this liquor was distilled with a moderate heat, till the spirituous and saline parts were drawn off, after which the superfluous moisture also was abstracted (or evaporated away), till the remaining substance was brought to the consistence of a somewhat thick syrup, or a thin extract. This done, it was well incorporated with thrice its weight of fine white sand, and the mixture being put into a strong stone retort, to which a large receiver (in good part filled with water) was so joyn'd that the nose of the retort did almost touch the water. Then, the two vessels being carefully luted together, a naked fire was gradually administered for five or six hours, so that what was either phlegmatick or volatile might come over first. When this was done the fire was increased, and at length for five or six hours was made as strong and intense as the furnace (which was not bad) was capable of giving, (which violence of fire is a circumstance not to be omitted in the operation). By this means there came over good store of white fumes, almost like those that appear in the distillation of oyl of vitriol; and when those fumes were passed and the receiver grew clear, they were after a while succeeded by another sort, that seemed in the receiver to give a faint, blewish light, almost like that of little burning matches dipped in sulphur. And, last of all, the fire being very vehement, there passed over another substance that was judg'd more ponderous than the for-

mer, because it fell through the water to the bottom of the receiver, whence being taken out (and partly even whilst it stay'd there), it appeared by several effects and other phenomena to be such kind of substance as we desired and expected."

Hanckwitz, the servant of Boyle, and working under his direction, at the laboratory in Southampton Street, London, succeeded, by his own skill and perseverance, in considerably improving the process or manufacture, and produced phosphorus in larger quantities than any other person. He confirmed the opinion of his master, that it required an intense heat for its extraction; he states, "for in truth and fact it is not a work for gentlemen and cabinet chymists, but there is required for it an operator well versed in fires, to whom its mechanick and manipulation is well known." In an advertisment he states:—"For the information of the curious, he is the only one in London who makes inflammable phosphorus which can be preserved in water. Phosphorus of Bolognian stone, flowers of phosphorus, black phosphorus, and that made with acid oil, and other varieties. All unadulterated; every description of good drugs. He sells wholesale and retail. N. B. He sells solid phosphorus, wholesale, fifty shillings an ounce, and retail three pounds sterling the ounce."

In a "Historical Sketch of the Progress of Pharmacy in Great Britain, by Jacob Bell," it is stated, that "a house and shop with a laboratory, were built on the Bedford estate, in the year 1706, by Ambrose Godfrey Hanckwitz, who had carried on business as a chymist in the neighborhood since 1680. He was a maker of phosphorus and other chemicals, which were rare at that period, and which he sold in different parts of the country during his travels. His laboratory was a fashionable resort in the afternoon on certain occasions, when he performed popular experiments for the amusement of his friends. It opened with glass doors into a garden, which extended as far as the Strand, but which is now built upon. Four curious old prints of the laboratory in its former state are in the possession of its present proprietors, Messrs. Godfrey and Cooke, of Southampton Street, Covent Garden, also a portrait of Ambrose Godfrey Hanckwitz, engraved by George Vertue (1718), which he had distributed among his customers as a keepsake."

When we consider that 1000 parts of urine contain scarcely one part of phosphorus, and of this probably only a portion was obtainable by the processes first in use, we shall not be surprised at the statement of Boyle that "the liquor yields but a small proportion of the desired quintessence," or at the price of 50s. an ounce charged by Hanckwitz for his product. Even an improved process, purchased and published by the French Government in 1737, yielded, under the direction of Hellot, Geoffroi, Dufay, and Duhamel only four ounces of phosphorus for every five hogsheads of the liquid.

After the death of Hanckwitz, in 1741, some experiments were made by Margraaf, Fourcroy, Vauquelin, and others; but no great improvement in the production of phosphorus appears to have been effected until 1769, when Gahn made the important discovery of phosphoric acid in bones. Margraaf had already demonstrated the individuality of this acid as early as the year 1740, and it only now remained to devise a process for extracting it. Scheele immediately did this, and various eminent chemists quickly succeeded in making various improvements in the method of working, and bequeathed unto us substantially the same process of manufacture as that now in operation.

The present sources of phosphorus are the bones of buffaloes and other animals, slaughtered in the great hunting-grounds of South America (the Pampas bordering the La Plata), where bones are used as fuel; exhausted "bone-black," or "animal charcoal" of sugar refineries; calcareous deposits of phosphate of lime, or "mineral guano" from the coast of Yucatan; and similar deposits from the Island of Sombreros; but the chief of these sources is the burnt bones from Monte Video, Rio Janeiro, Rio Grande, &c., and the animal charcoal of the sugar refineries. These various substances contain from 60 to 90 per cent. of their weight of phosphate of lime, or from 12 to 18 per cent. of phosphorus.

The phosphorus-yielding material, of whatever kind, having been suitably ground, a weighed quantity of the powder is placed in a large circular tub, lined with lead, with a mixture of oil of vitriol and water, and stirred by means of a revolving wooden stirrer, driven by a steam-engine, steam being admitted by a

pipe into the mixture to facilitate the action of the sulphuric acid upon the powder.

The changes which bone-ash or other varieties of phosphate of lime undergo in the above operation are these: the oil of vitriol or sulphuric acid gradually unites with the lime and forms sulphate of lime, and sets the phosphoric acid free; so that after the process there remains a semi-fluid mixture of a solid substance, sulphate of lime (gypsum or plaster of Paris), with a fluid body, phosphoric acid, separable by filtration.

The creamy mixture is now transferred, by means of ladles, to a filter or drainer, from which, with the aid of occasional stirring, the phosphoric acid filters into a vessel beneath. Water is added to the drained contents of the filter until the drainings cease to taste acid. The sulphate of lime or gypsum is then removed, in its damp state, to a furnace or other source of heat and dried, and constitutes a residuary product suitable for the manufacture of artificial manures.

The dilute filtered solution of phosphoric acid, containing some phosphate of lime and a small quantity of sulphate of lime dissolved in it, is transferred to leaden vessels and slowly evaporated over a gentle fire; the small quantity of gypsum then deposits itself upon the bottoms of these vessels and is removed by scraping. The liquid is deprived of as much more of its water as possible by further evaporation in similar vessels, and cooling acquires the consistence of cocoa-nut butter.

The butter-like paste is then well mixed with a due proportion of powdered charcoal, and the mixture heated in furnaces of brick or iron until it is brought into as dry a powder as can be attained. The powder consists of charcoal, phosphoric acid (a compound of phosphorus and oxygen), a little phosphate of lime, and a little water, which is chemically combined with the phosphoric acid, and not capable of removal by the means yet applied.

We have already alluded to the intense heat employed by Boyle and Hanckwitz in their distillation of phosphorus; the same is also necessary in the present mode of manufacture. The vessels in which the phosphorus is separated consist of a number (about ten) of small retorts, of a convenient shape, carefully constructed of the most refractory fire-clay, narrowed at

their mouths, and arranged nearly close together in a horizontal row in a furnace, somewhat similar to the retorts in a gas-works. They are placed in a nearly horizontal position, with their open ends slightly raised, and in a furnace so constructed as to subject them to nearly a white heat.

The black powder is introduced into the retorts when the latter are comparatively cool, and the retorts are about half filled with the mixture. Bent pipes, open at both ends, are inserted, air-tight by means of clay, into the mouths of the retorts, and their outer ends dip into warm water, in cast-iron basins, placed to received the distilled phosphorus. I may now incidentally remark that all the manipulations with ordinary phosphorus in its simple and separated state are performed under the surface of water, otherwise it would quickly inflame and be reconverted into phosphoric acid.

The heat of the furnace is gradually raised, and in the course of some hours phosphorus begins to distil over, and accumulates in a melted state in the basins of water. The fire is still further raised, by gradual means, until a most intense heat is obtained; the phosphorus then distils rapidly. The heat, after being thus continued as long as any more phosphorus appears, is gradually decreased, and the basins containing the crude phosphorus are removed. The time occupied in the distillation is, in some cases, protracted from forty-eight to seventy-two hours.

In this operation the charcoal, at a high temperature, combines with the oxygen of the phosphoric acid, forming therewith carbonic oxide and carbonic acid gases, which escape through the nose-pipe, and the phosphorus thus set free is converted into vapor by the heat and distils over into the receiving basins. At the same time, the portion of water not extracted by the preceding process is also decomposed, and its hydrogen set free, combines with some of the phosphorus and forms, phosphuretted hydrogen gas. The inflammable gases, carbonic oxide, and phosphuretted hydrogen, are conducted away from the phosphorus basins by means of a pipe, and consumed.

When the distillation is at an end the furnace is cooled down and the residuary contents of the retorts extracted. The residue consists chiefly of charcoal (of which there is always an excess), and of undecomposed phosphate of lime, together with a

few impurities, and is used in the composition of manures, the phosphorus in it being of too difficult or too unprofitable extraction. From the penetrating and destructive character of phosphorus, the retorts require frequent renewing, some manufacturers, when the best fire-clay is not employed, not using them for more than one operation.

The appearance of a phosphorus distillery containing between 200 and 300 retorts, which we have frequently visited when in full operation, and the furnaces at their maximum heat, is somewhat fearful:—The long, yellow flames of phosphuretted hydrogen, and carbonic oxide shooting forth from the escape pipes; bits of burning phosphorus spitting forth in fiery balls from little crevices or leaks at the mouths of the retorts; the incessant bubbling of the vapor of phosphorus and escaping gases in the basins of hot water; the almost unbearable heat from the furnaces on each side, and from the red-hot flues under foot; the intolerable stench of phosphuretted hydrogen and burning phosphorus; together with the acid fumes, and filthy, grim aspect of the place, combined to produce an impression on our senses which we cannot fail to remember.

The small cakes of crude phosphorus, each weighing several pounds, are collected from the iron receiving basins when cold, and melted together under water. The impurities which were carried over from the retorts into the basins by the current of gases and phosphorus vapor, now settle to the bottom of the fluid mass, and the supernatant phosphorus is drawn over into shallow copper pans, containing a small quantity of hot-water to prevent contact of air, by means of leaden syphons previously filled with hot water, and allowed to solidify.

The large cakes or cheeses of phosphorus thus obtained still contain impurities, and are of a dirty red color, chiefly arising from the mechanical admixture of a red variety of phosphorus in small particles. They are broken to pieces under cold water, and the fragments placed in hot water contained in a leaden vessel (heated by steam), together with a bleaching agent. The phosphorus is stirred with the heated mixture until it is bleached, or its brownish color is removed, which generally occupies two or three hours.

The liquid phosphorus is again drawn by means of syphons into

shallow copper pans, and allowed to solidify. It is then broken under water, and the pieces are placed in hot water in a double-sided (or steam-jacketed) vertical iron cylinder, lined with lead, with a perforated bottom covered with chamois leather and canvass, and while in the fluid state pressure is applied to the phosphorus, and it passes through the leather, &c., into a vessel of hot water beneath, leaving the residuary impurities, red phosphorus, &c., upon the cloth in the form of a dirty reddish substance of an earthy appearance.

The bleached and purified phosphorus is now cast into wedge-shaped pieces, or it is moulded into cylindrical sticks, half an inch in diameter, and ten inches long, by the aid of glass tubes immersed into the phosphorus under water, or by means of an apparatus with tubes specially contrived for the purpose. On some occasions the phosphorus is very brittle and difficult to draw into sticks, but if it is in a satisfactory pure state it is as ductile as lead or soft copper wire. The appearance of the purified phosphorus in the form of wedges is that of very transparent wax or glass of a slightly greenish-yellow color, but when in the form of sticks it usually appears colorless. It is needful on all occasions to protect the purified substance from strong daylight, otherwise it soon becomes yellow and opaque. For conveyance it is always packed in water, generally in tin cans, the covers of which are soldered air-tight.

The phosphorus we have described is that of the ordinary kind, but there is another variety equally pure, discovered in 1848 by Professor Schrötter, of Vienna, which is produced as follows: The ordinary phosphorus in its purified state is placed under water in a cast-iron boiler over a furnace; then melted, cooled, and the water removed from its surface. The vessel is then immediately and securely closed, air-tight (except a small iron-tube for the escape of vapor), by a cast-iron cover. The lid has a vertical iron tube, closed at its lower end, fixed in it, which projects downwards into the phosphorus, and is open at its upper end for the reception of a thermometer. Heat is now gradually applied by means of the furnace until the phosphorus is at about 450° Fah., and that temperature is maintained for a greater or less period of time, according to the amount of phosphorus operated upon, and the mass is then allowed to cool. A quan-

tity of about 200 pounds is kept heated about three or four weeks. After this process the vessel is opened, and the phosphorus, which has now become a hard, red, brick-like substance, is covered with water, and extracted by means of iron bars, &c. This process of conversion requires to be conducted with great circumspection, otherwise (from overheating of the phosphorus) fearful explosions may ensue; experience has, however, shown that they may be almost wholly avoided.

For commercial purposes the red or amorphous phosphorus, as it is termed, is required to be in a state of fine powder; the stony fragments are, therefore, broken into small pieces under water in a mortar, and ground under water between pieces of mill-stone in a vessel supplied with a small stream of water, which carries off the finer particles in its overflow stream into a large tank, where they gradually subside, or into a filter where they are collected. A process is then resorted to for the separation of any ordinary phosphorus which the powder may contain.—*Chem. News, London, July*, 1861.

(To be continued.)

FORMATION OF THE GREEN MATTER OF LEAVES UNDER THE INFLUENCE OF THE ELECTRIC LIGHT.

M. Hervé Mangon has published the results of some experiments made by him, with a view of ascertaining whether the green matter of leaves, &c., would be formed when a plant was submitted solely to the influence of the electric light. It is well, known that a plant grown in darkness is devoid of green color and it is generally considered that the sun's light is essential to its development. From M. Mangon's experiments it appears that the electric light is equally capable of inducing its formation.

The electricity was produced by an electro-magnetic machine worked with a steam engine. The light was obtained from a lamp with charcoal points. The light was maintained for eleven hours on the 30th July, twelve hours on the 31st July and 1st and 2d of August, and eleven hours and a half on the 3d of August. The temperature of the air varied from 22° to 25° C., and the earth from 19° to 21° C. In the morning of the 30th

July several flower-pots, each containing four grains of rye, sown respectively on the 24th, 26th, 27th, and 28th of July, were placed in a large space perfectly secluded from external light, the pots standing about one metre from the electric lamp, and half a millimetre below the point of light. The grains sown on the 24th and 26th had sprouted, the stems being about $0.^{m}005$ to $0.^{m}012$ in length. One of these small plants presented the commencement of a green tint at the point, the others were white. By the middle of the day of the 31st the plants of the 24th and 26th had grown to $0.^{m}01$ and $0.^{m}06$ in length; they were *very green*, and strongly inclined towards the light. The plants of the 27th had sprung up and were green at the tips. By the 2d of August all the plants had developed as well as if they had been in the open air, and all exhibited their natural green color. On the 3d of August the experiment was brought to an end. It is scarcely necessary to add that some corresponding seeds grown in darkness for the same period were perfectly yellow.

It follows from the above that the electric light, like sunlight, is capable of causing the development of the green parts of plants. It has been previously shown that the light resulting from very intense combustion, such as results from pyrotechnic compositions for instance, is capable of producing the same effect.—*Lond. Pharm. Journ., Oct.*, 1861.

ON TINKALZITE (BORATE OF LIME AND SODA) FROM PERU.

By T. L. Phipson.

Phil. Nat. Doct. Bruxelles University; Member of the Chemical Society of Paris, &c. &c.

The useful mineral of which I am about to speak was discovered only a few years ago in the deposits of nitrate of soda in Peru. It is now imported into Europe in considerable quantities as a substitute for borax. It was first examined in 1850 by M. Ulex, who found that it contained boracic acid, lime, and soda; but the analysis published by this author shows too small a quantity of water, and too much boracic acid. In 1859, M. Kletzinsky received some samples of this same mineral from the Western Coast of Africa, and the analysis he has made of them

coincides pretty well with my analysis of some specimens from Peru.

Tinkalzite is found in the layers of nitrate of soda of Southern Peru, in the shape of globular masses, which the natives call *tiza*, and which vary in size from that of a nut to that of a potato. The outer crust of these tubercles is rather hard; but they are easily broken, and are then seen to be formed, in the interior, of a mass of crystalline needles, intersecting each other in all directions, and of a brilliant white satiny appearance. Often these globular masses contain reddish crystals of gypsum and other minerals; and they always contain a certain quantity of common salt, which gives to the mineral a brackish taste.

Water extracts from tinkalzite all its chloride of sodium and borax; acids easily dissolve the whole mineral, leaving only a small residue of very fine sand.

The density of tinkalzite I find to be 1.93 (according to M. Kletzinsky, = 1.9212; and according to M. Ulex, the satin-like fibres = 1.8).

The analysis of the mineral in question has given me the following result, by the side of which I have placed the analysis of M. Kletzinsky:—

	American Tinkalzite. Phipson.	*African Tinkalzite.* Kletzinsky.
Water	34 00	37.40
Soda	11.95	10.13
Lime	14.45	14.02
Boracic Acid	34.71	36.91
Chlorine	1.34	1.33
Sulphuric Acid	1.10	0.50
Silica	0.60	"
Sand	2.00	"
Phosphoric Acid	traces	"
Alumina	"	"
Magnesia	"	"
	100.00	100.00

The difference in the quantities of water, as shown in these two analyses, is owing to the gradual loss of water by soda-salts when exposed for some time to the air.

By neglecting the accidental elements, and calculating the

water, soda, lime, and boracic acid, we arrive at the formula—

$$(NaO,2BoO_3+10HO)+2(CaO,BoO_3+2Ho)+2HO.$$

Borax. Borate of lime. Water.

The presence of the other substances given by analysis seems to indicate that this mineral has been formerly deposited by mineral springs; and the fact that the biborate of soda it contains has crystallized with 10 equivalents of water, shows that the temperature of these springs could not have been greater than+55° (Centigrade). As it is imported from America for industrial purposes, tinkalzite contains about 70 per cent. of borax, 25 per cent. of borax of lime, and 2½ per cent. of chloride of sodium. It forms an excellent flux for metallurgical purposes, and has been employed with success in the porcelain manufactories of Sèvres by M. Salvetat. In fact, it appears capable of effectually replacing borax in all the applications of this rather expensive salt to industrial or manufacturing processes.

To extract boracic acid from tinkalzite, a given quantity of hydrochloric acid is diluted with water, and saturated while boiling with the pulverized mineral; the clear solution is decanted while hot, and upon cooling the liquid throws down the boracic acid in large quantities.—*Lond. Pharm. Journ., Oct.*, 1861, *from Technologist.*

ON THE PROPERTIES OF SULPHATE OF ANILINE.

(*Read before the British Association.*)

Dr. Turnbull, of Liverpool, read a paper "On the Properties of Sulphate of Aniline"—a new remedy which he had used with success in the treatment of chorea, or St. Vitus's dance. He said that medical men had not acquired a knowledge of the properties of new remedies commensurate with the advances which had been made in other branches of medicine. The progress of organic chemistry had brought to light many new bodies worthy of investigation; and there could be little doubt that many of them would, if their properties were investigated, be found to prove remedies of utility. The artificial alkaloids were a numerous class, and from their resemblance in chemical constitution to the vegetable alkaloids, such as quinine, morphia, &c., it might reasonably be expected that some of them should have

powerful and useful properties. He had made some trials of more than one of them, and especially of the sulphate of the artificial alkaloid aniline, which he had administered in cases of nervous disorder. He then proceeded to give an account of six cases of chorea which he had treated successfully with this new remedy. The first was the case of a girl aged thirteen, who had involuntary twitching movements in all the limbs, and was for two months under the usual treatment, but without deriving the slightest benefit till the sulphate of aniline was given. She then recovered rapidly and got quite well. The second was a case in which the left side was chiefly affected, and the recovery was perfect in twenty-one days. The third was a case in which the twitching movements were brought on by a fright, and the recovery took place in fourteen days. The fourth and fifth were cases of recovery from the ordinary form of the disease. The sixth was a case of unusual severity, with partial loss of power of the lower limbs and inability to speak. Rapid and perfect recovery was, however, effected in this case by means of the same remedy. He adverted to two other cases in which sulphate of aniline had been used with success by other medical men; and he expressed the conviction that it would be found by the profession to be a valuable new agent in the treatment of this class of nervous diseases. In regard to the physiological action, he stated that aniline appeared to act directly on the nervous system. The most remarkable effect, however, which it produced was a transient alteration in the color of the skin and lips, which he attributed to oxidation of the aniline and the formation of a coloring matter in the blood. But this, it was observed, must be speedily eliminated from the system, as the natural color was restored as soon as the remedy was laid aside.

The President (Dr. Davy), in proposing a vote of thanks to the author of the paper, drew attention to the physiological action; and in the discussion which ensued Dr. Moffatt and other gentlemen took part.—*Lond. Pharm. Journ., Nov.* 1861.

ON PERCHLORIC ACID AND ITS HYDRATES.

By Professor Roscoe.

(Read before the British Association.)

All the knowledge we possess of the quantitative relations of perchloric acid is the determination of the composition of the potassium salt, first analyzed by Stadion in 1816, and afterwards by many other chemists. The perchloric anhydrous acid has not been isolated, and no analysis of the aqueous acid has ever been made. We can only account for the neglect with which chemists have treated the highest and yet the most stable of the oxides of chlorine, by the fact that the preparation of the acid in large quantities has been attended with great difficulties. The best method for preparing aqueous perchloric acid is to decompose chlorate of potassium with hydrofluosilicic acid, to boil the chloric acid thus obtained down, which splits up into lower oxides of chlorine, which escape in the gaseous state, impure perchloric acid being left behind, which is purified by distillation. The acid thus obtained is in appearance not to be distinguished from oil of vitriol, being a colorless, heavy, thick, oily, corrosive liquid, giving off by heating dense white fumes. By heating the aqueous perchloric acid with four times its volume of concentrated sulphuric acid, the latter takes water from the first, dense white fumes are evolved, a yellow mobile liquid distils over, afterwards thick oily drops appear, which, when coming in contact with the yellow liquid, form white crystals, previously obtained by Serullas, but in such small quantities that he was unable to analyze that substance, which, prepared in this way, contain always sulphuric acid, and is therefore not fit for analysis, and requires re-distillation. Heated, however, to 110° C., the crystals decompose, and split up again in the yellow liquid, which distils over at a low temperature, and the thick oily liquid remains in the retort. The yellow liquid thus obtained is pure perchloric acid, a body not known before, and can be obtained also by distilling one atom of perchlorate of potassium with four atoms of sulphuric acid. In the pure state it is perfectly colorless, but commonly slightly yellow, owing to the presence of lower oxides of chlorine. Perchloric acid is one of the most powerful oxidizing agents known; a single drop

brought into contact with charcoal, paper, wood, alcohol, &c., immediately causes explosive combustion, falling not short in violence of that of chloride of nitrogen, and brought on the skin fearful wounds are produced, which do not heal for months. Like nitric acid, it cannot be distilled without decomposition, but it darkens, and heated stronger, decomposes with explosion. It cannot be kept for any length of time; even sealed up in glass bulbs, which are placed in the dark, it decomposes suddenly after some time, smashing the vessel containing it. It mixes with water with a hissing noise and evolution of heat, uniting and forming the same crystals which were mentioned before, and was used for preparing the pure acid. Those crystals are the monohydrated perchloric acid. They melt at 50° C., and heated to 110° C., split up in pure perchloric acid, which distils over, and an oily liquid boiling at 200°, which is also obtained by boiling aqueous perchloric acid till dense white fumes are given off. That oily acid has a constant composition containing 72.3 per cent. pure perchloric acid and 27.7 per cent. of water. This per-centage corresponds, however, to no definite hydrate of simple atomic composition, but follows the same general relations respecting composition and boiling point, which, as I have shown previously, hold good for so many aqueous acids, namely, that the phenomena of constant boiling point and constant composition depend chiefly upon physical, and not on chemical, attractions.—*Proceedings of the British Association, from the Manchester Guardian.*

EXPERIMENTS ON THE BEST MODE OF CORRECTLY ESTIMATING THE PER CENTAGE OF ALCOHOL EXISTING IN WINES.

By John Horsley, F.C.S. London.

Analyst to the County of Gloucester.

First, note the specific gravity of the wine to be tried, say that compared with distilled water at 1000, it is ·997, or 3 short of that number; then take 5 fluid ounces of the wine and evaporate it by rapid boiling in a sufficiently capacious flask to 2 ounces; then place the flask in a pan of water for a short time

to cool. By this operation you will have expelled not only all the spirit, but a good portion of water with it.

Next make this residuary liquor containing the sugar and other extractive matter of the wine, minus its alcohol, up to the original bulk with distilled water, and take its specific gravity, which in this case will be 1·020. If this excess of 20 over the weight of the standard of distilled water be deducted from the specific gravity of the wine thus,—

·997 including its spirit, water, and other extractive matter of the grape;
20 amount of extractive matter in the water only;

·977 will be the true specific gravity of the spirit and water contained in the wine, minus the extractive matter, which is equal to 17 per cent. of alcohol, according to the published tables of alcoholic strengths at different densities and temperatures. Or, which is nearly the same thing, we may proceed by subtracting the specific gravity of the wine, ·997, from the residuary liquor, thus 1·020
997

leaving ·23, which, deducted from the standard of distilled water 1000
23

leaves ·977 as the true specific gravity of the spirit and water in the wine.

These examples may be further verified by a distillatory experiment thus :—Take 5 ounces of the wine; distil off exactly half by a gentle heat from a graduated retort to which a receiver is connected till oiliness ceases to form in the tube end of the retort, indicating that all the alcohol has passed over. The specific gravity of this distillate (consisting of spirit and water) will be ·955, equal to 34 per cent., which, divided by 2,—as only half the bulk has been drawn over—gives 17 per cent. Or the distillate may be diluted with its own bulk of distilled water up to the original 5 ounces, when its specific gravity will be ·977, equal to 17 per cent. of alcohol.

This per-centage may be converted into Revenue proof spirit by rule of three sum, thus:—

	Alc.	Wat.	Alc.		
As	49	: 51	: : 17	= 17·69	water.
				17	alcohol.
Proof	.	.		34·69	

Chem. News London, Oct. 19, 1861.

ON RUBIDIUM AND CÆSIUM.

By M. Bunsen.

In addition to the facts which we have already published on the subject of these two metals, discovered by M. Bunsen, by means of spectrum analysis, we add the following:—

The equivalent of rubidium is 85·36 (H = 1), more than double than of potassium; metallic rubidium is even more electro-positive than potassium,—it amalgamates easily and decomposes water in the cold.

The hydrate of rubidium, RbO.HO+Aq, is soluble in all proportions in water and alcohol. When heated it fuses in its water of crystallization, becoming reduced to the state of RbO.HO, which is fusible at a higher temperature without losing weight. It acts like caustic potash, attracting water and carbonic acid from the air, and dissolves in water with disengagement of heat.

The carbonate, $RbO.CO_2+Aq$, forms ill-defined crystals, of strong alkaline reaction, fusible by heat in their water of crystallization, and becoming anhydrous. This salt is fusible, deliquescent, and attracting from the air a second equivalent of carbonic acid. The aqueous solution saponifies the skin exactly like carbonate of potash.

The bicarbonate, RbO.2CO+HO, forms brilliant prisms, unalterable in the air, having a slight alkaline reaction, and a saline taste not at all caustic.

The nitrate, $RbO.NO_5$, does not crystallize in rhombohedral prisms like saltpetre, but in prisms with a hexagonal base, which is a second form of nitrate of potash. It dissolves in 5 parts of water at 0° C., and in 2·3 parts of water at 10° C.

The sulphate, $RbO.SO_3$, is isomorphous with that of potash. At 7° C. it dissolves in 2·4 times its weight of water, and is, consequently, more soluble than sulphate of potash, which requires 10·4 times its weight of water to dissolve it. With sulphate of magnesia it gives a beautiful octohedral salt, and with sulphate of cobalt another double salt, in fine crystals, isomorphous with $CoO.SO_3+KO.SO_3+6HO$.

The bisulphate of rubidium can be fused at a moderate temperature without decomposition, but at a higher temperature it is reduced to the neutral salt.

The chloride of rubidium is cubic, but crystallises with difficulty. It is fusible and volatilizable at the extremity of a platinum wire. From 1° to 7° C. it dissolves in 1·2 to 1·3 parts of water; KCl requires 3·4.

The double chloride of platinum and rubidium, RbCl.PtCl is a crystalline powder composed of microscopic octohedra. It only differs from the double chloride of platinum and potassium by its less solubility; it only dissolves, indeed, in 158 times its weight of boiling water, whereas the potassium salt only requires 19 times its weight.

Cæsium (from *cæsius*, sky-blue, on account of the color of the ray which it produces in the spectrum). The double chloride which it forms with platinum is still less soluble than that of rubidium. Its equivalent ranks by the side of those of iodine and gold, 128·4, and is consequently, one of the highest.

The hydrate of cæsium, CsO.HO+Aq, is deliquescent. When heated it loses an equivalent of water, attacks platinum, volatilizes in a spirit-flame, and easily dissolves in alcohol.

The carbonate, $CsO.CO_2+Aq$, crystallizes badly; at 19° C. it dissolves in 9 times, and at 78·4° C. in 5 times its weight of absolute alcohol. It is very caustic, liquefies in the air, and is transformed into bicarbonate. It is soluble in all proportions in hot water.

The bicarbonate crystallizes in brilliant prisms.

The nitrate is anhydrous, like that of potash, with which it is isomorphous. It has the taste of saltpetre, as also has the nitrate of rubidium.

The sulphate of cæsium is also anhydrous, and crystallizes

badly. At 2° C. 1 part of this salt requires 0·63 parts of water to dissolve it. It forms double salts with the magnesian sulphates, and these double salts are isomorphous with those formed with the same sulphates and the sulphates of potash and ammonia. With sulphate of alumina the sulphate of cæsium forms a very brilliant octohedral alum.

The chloride crystallizes in cubes, but it is distinguished from those of potassium and rubidium by being deliquescent, like the chloride of lithium. It is fusible and volatile at a comparatively moderate temperature.

Cæsium is less abundant than rubidium, which, however it generally accompanies; the richest source is the mineral water of Durckheim. 10 kilogrammes of this water contain 2 milligrammes of chloride of cæsium; and it has been from the residue of the evaporation of this water that I have prepared it, by precipitating it with bichloride of platinum, and submitting the alkaline chloroplatinate to successive exhaustions with boiling water until only the chloroplatinate of cæsium was left, this, as we have seen, being the most insoluble of all, and possessing also the highest equivalent.

The lepidolites contain only traces of cæsium, but, on the contrary, they are rich in rubidium, and it is from these that M. Bunsen has prepared the latter. The lepidolite from Rosena (Moravia) contains two-thousandths of its weight of oxide of rubidium, and that from Saxony appears still richer. Probably all the saline mineral waters contain it; that of Durckheim contains two-millionths, and the mother-liquor about four hundred-thousandths of chloride of rubidium. Commercial potash, however, does not always contain it.—*Chem. News, London, Oct.* 26, 1861, *from Annal. der Physik und Chem.*

ON THE PREPARATION OF NITRATE AND NITRITE OF ETHYL.

By M. Carey Lea.

Nitrate of Ethyl.—The tendency of alcohol to decompose nitric acid is so great, that while we have any number of processes for obtaining nitrite of ethyl, Millon's is the only one known for forming the nitrate. But Millon's process fails much oftener than it succeeds (such, at least, has been my experience), in

consequence of the proportion of urea directed to be used being much too small.

Millon's process, as quoted in Kolbe's "Organische Chemie," directs to distill equal weights of alcohol and of colorless nitric acid, specific gravity 1·401. Not to operate upon larger quantities than 120 to 150 grammes, and to add a little urea to the above quantity, at most ("höchstens") 2 grammes of urea.

Conducted as above, the operation succeeded with me but once out of four or five times. But by using a large quantity of urea, three or four times as much, or even more, success invariably follows, and there results a great saving of urea, because when the process fails, the materials, urea included, are entirely lost, whereas when conducted as just described, very little urea is consumed. It is only necessary to add fresh acid and alcohol, after the first proportion had been distilled to about one-fifth, and the process may be repeated almost indefinitely, with the occasional addition of a little urea to keep up the proportion. The product in the second and subsequent operations is much larger than in the first.

Nor have I found it necessary to operate on the small quantities above mentioned, but have habitually used quantities amounting to 400 to 500 grammes, and should not hesitate to employ still larger ones. It is, however, more convenient to use the above quantity, and replace the material as fast as exhausted.

The facility with which nitrate of ethyl can be obtained by the above process must, I think, give it a decided advantage over the iodide of ethyl for the preparation of the ethyl bases, in the manner which I have recently described. The lower equivalent of nitric acid as compared with iodine is a matter of considerable importance; 100 parts of iodine are capable of holding in combination something less than 23 of ethyl, whereas 100 parts of nitric acid combine with over 53 of ethyl,—a material point, as the iodine on the one hand and the nitric acid on the other are merely the vehicles for bringing about the ethyl substitution. In operations in pressure-tubes, where space is valuable, this is an important consideration; in an economical point of view also the advantage appears to be greatly on the side of the nitrate of ethyl.

Nitrite of Ethyl.—The action of nitric acid on alcohol in the preparation of nitrite of ethyl may be conveniently moderated by protosulphate of iron, and the nitric acid reduced by that agent instead of at the expense of part of the alcohol. The proportions which I have used are, nitric acid, specific gravity 1·37, 90 cubic centimètres; alcohol, of 90 per cent., 150 cubic centimètres; ferrous sulphate, 45 grammes. The product is very large; the distillate, on being shaken up with water, yields more than half its bulk of nitrite of ethyl. The latter is not perfectly free from aldehyde, but more so than that obtained by some other processes. The action is perfectly quiet to the last, and the distillation may be carried on rapidly.—*American Journal of Science and Art, Sept.*, 1861.

ON THE MANNA OF SINAI, AND THE MANNA OF SYRIA.

By M. Berthelot.

'They took their journey from Elim, and all the congregation of the children of Israel came unto the wilderness of Sin, which is between Elim and Sinai. . . . And the whole congregation of the children of Israel murmured against Moses and Aaron; and the children of Israel said unto them . . . Why have ye brought us forth into this wilderness, to kill this whole assembly with hunger? Then said the Lord unto Moses: Behold I will rain bread from heaven for you. . . . And behold upon the face of the wilderness there lay a small round thing, as small as the hoar frost on the ground. And when the children of Israel saw it, they said one to another: *Manhu?* which signifies: What is it? . . . And the house of Israel called the name thereof Manna. . . . The taste of it was like honey. . . . And the children of Israel did eat Manna forty years. . . . They did eat Manna, until they came to the borders of the land of Canaan.—*Liber Exodi*, cap. xvi.

What is the substance described in the preceding recital, which figures so much in the history of the Hebrew nation, and the name of which serves as a type of a multitude of natural sugary substances? Can it be likened to any saccharine matter known in the present day? This is a very controverted question. Two principal opinions are current on this point: the one regards manna as a sugary exudation supplied by various shrubs, principally by the *Alhagi Maurorum* (Tourn.), a kind of saintfoin; the other opinion likens the manna of the Hebrews to a species of cryptogamous plant. In these days the origin

of the manna gathered at Sinaï may be regarded as settled, according to the researches made upon the spot by MM. Ehrenberg and Hemprich. "Manna," says Ehrenberg, "is found at the present time in the mountains of Sinaï; it falls upon the earth from the regions of the air (that is to say, from the top of a shrub, and not from the heavens). The Arabs call it *Man*. The indigenous Arabs and the Greek monks collect it, and eat it with bread in the same way as honey. I have seen it fall from the tree, I have gathered it, brought it myself to Berlin with the plant and the remains of the insect." This manna flows from the *Tamarix mannifera* (Ehr.) Like a number of other mannas, it is produced under the influence of the puncture of an insect, the *Coccus manniparus* (H. and Ehr.)

If the origin of the Sianï manna be thus established, it is not so with its chemical nature. And this is a subject the more interesting, because the chemical analysis can alone explain its character as a nutritive agent. The result of my researches among sugary substances has led me to make some experiments in this respect. I have operated upon the following substances, the one identical with, the other analogous to, the manna of Sinaï:—1st. The Manna of Sinaï; 2ndly, The Manna of Syria, or rather of Kurdistan.

1st. The Manna of Sinaï.

The specimen was given to me by M. Decaisne; it was produced from the *Tamarix mannifera;* it had been gathered and brought home by M. Leclerc, who accompanied the Princes of Orleans in a voyage to the East (1859—1860).

This manna presents the appearance of a yellowish syrup, thick, and containing vegetable remains. It contains cane sugar, interverted sugar, dextrine, and water. The weight of the water was about a fifth of that of the whole mass. Its composition, after the removal of the water and vegetable remains, was as follows:—

Cane sugar, ...	55
Interverted sugar (levulose and glucose), .	25
Dextrine and analogous substances, . .	20
	100

2d. Manna of Kurdistan.

The specimen was given to me by M. L. Soubeiran; it had been sent to Paris by Dr. Gaillardot. It had been gathered on the mountains of Kurdistan, to the N. E. of Mossoul. Subjoined is the information on this subject in a letter addressed to M. Gaillardot by M. Barré de Lancy, then Chancellor to the Consulate of France at Mossoul. This manna "falls without distinction on every plant in July and August, but not every year; there has been very little for the last three years. It is gathered by cutting the branches, which are left to dry for two or three days in the sun, when they are shaken, and the manna is obtained, which falls like dust. The Kurds use it without purifying it. They mix it with dough, and even with meat." The matter presents itself under the form of a pasty mass, almost solid, impregnated with vegetable matter, and especially with the leaves of the nut-gall tree. It contains cane sugar, interverted sugar, dextrine, water, and, lastly, a small quantity of green waxy matter. This is the composition of the part soluble in water:—

Cane sugar, ...	61.
Interverted sugar (levulose and glucose), .	16·5
Dextrine and analogous substances, . .	22·5
	100·0

From the preceding results, we see that the manna of Sinaï and that of Kurdistan are essentially composed of cane sugar, dextrine, and the products of the alteration, without doubt, of these two principles. Their composition is almost identical, a result the more singular, because the plants which produce these two mannas belong to two extremely different species. Nevertheless, this phenomenon is not without analogy. Thus we know, that the honey gathered by bees from very different flowers possesses a composition almost identical. This is not the only comparison which may be made between honey and the manna in question. Not only do insects concur equally in the formation of honey and that of the manna of Sinaï, but further, this manna, as well as honey, is composed of cane sugar and interverted sugar; the manna of Sinaï contains beyond this, dextrine, and the products of its alteration.

If we return now to the historical recital of the manna of Sinaï, it is easy to explain the use of this substance as a food. In short, it is a true honey, perfected by the presence of dextrine. We see, at the same time, that the manna of Sinaï does not suffice as an aliment, since it does not contain any nitrogenous principle. Therefore, animal food is associated with it, as well in the actual usage of the Kurds as in the biblical narrative.—See Exodus xvi. 8—13.—*London Pharm. Journ., Nov.*, 1861, *from Comptes Rendus.*

ON THE OLEAGINOUS MATTER FORMED ON DISSOLVING DIFFERENT KINDS OF IRON IN DILUTE ACIDS.

By Emerson J. Reynolds.

Proust, I believe, was the first chemist who noticed that the hydrogen prepared by dissolving black cast iron in dilute sulphuric acid possessed a most offensive odor, and that on being passed through glass tubes, it caused them to assume a greasy appearance, apparently due to the deposition of an oily matter, which he appears to have considered as a combination of hydrogen and iron, the non-production of which body, under the circumstances, I will demonstrate further on.

Berzelius then afterwards noticed the formation of this oleaginous body, and gave it as his opinion that it was a compound of carbon and hydrogen. More recently, Professor Cameron in (1855) made some experiments on this oil, the results of which he communicated to the Chemical Society of Dublin. He found it to be very volatile, and destitute of nitrogen, and also that certain metallic salts removed the offensive odor produced by its presence.

But, after all, two very important points have been left undetermined, namely, the precise conditions under which this body is formed, and its chemical and physical characters and relations.

Now, it is the first of these propositions that I intend dealing with in the present paper, reserving the second for a future communication. I had contemplated waiting until my investigations were completed, before publishing the results; but in consequence of some observations made by M. Chevreul, before the

Academy of Sciences of Paris, I thought it better to bring forward what I have determined up to the present time. M. Chevreul stated that the combination of the iron with the hydrogen seemed difficult to admit, and that this consideration had led him to conjecture that the water might assist in the producduction of the oily matter. He, moreover, considered that the researches of M. Fremy* on cast iron and steel, seemed to throw some light on the subject, by indicating that it is not carbon, as was represented, which yields the oily body. Now, we can clearly gather from this, that M. Chevreul points to nitrogen as being, possibly, the principal constituent of the oil, and not carbon.

In order to clear away all doubts as to its origin, it was essentially necessary to answer the three following propositions:—

1. Is the oleaginous body produced during the solution of *pure* iron in dilute acids?

2. Does iron, free from every other impurity but carbon, yield the oil when treated with acids?

3. Will iron, containing nothing but nitrogen, furnish the oily matter on similar treatment?

It will be seen at a glance, that the careful solution of these propositions would be certain to make us acquainted with the circumstances which influence its production.

The following are the methods which I adopted for answering each question:—

1. My first object was to prepare absolutely pure iron. This I procured by the process generally employed for preparing "*fer reduit*," care being taken to preclude any possible chance of impurity. The peroxide being precipitated from the pure perchloride by ammonia, after being well washed, it was then submitted to a low red heat. Moreover, the hydrogen gas used to decompose the peroxide was evolved from distilled zinc and pure sulphuric acid. The metallic iron so procured, when dissolved in dilute acid, did not yield the slightest trace of the oil. I did not come to this conclusion after one or two experiments alone, but after repeated trials. This overthrows at once the

*See *Chemical News*, vol. iii. p. 332.

supposition that the iron combines directly with the nascent hydrogen forming the oil, and, indeed, does more, for its non-formation tends to confirm, if such were necessary, the opinion of Dr. Cameron, formerly expressed in this Journal, that such a compound as ferruretted hydrogen does not exist.

2. In answering the second question, it was essential to obtain iron containing some carbon in combination; this I prepared as follows:—Carburetted hydrogen in a pure state was passed over the iron of Experiment 1, heated to redness; the action was allowed to go on for half an hour. In this way I obtained iron containing carbon—in fact, cast iron. This compound, when dissolved in acids, gave the oil in such quantity as to allow of its being identified with the greatest ease. This experiment proves with certainty that carbon is essential to the existence of the oil, though, of course, it does not furnish us with any information as to whether the elements of water enter into its constitution or not. This can only be found by its ultimate analysis.

3. The third point to be considered in connection with this subject is, whether or not nitrogen gives rise to any oil. To determine this, another portion of the iron of Experiment 1 was submitted to the action of dry ammoniacal gas for nearly two hours and a half, by which means it became highly nitrogenised (as was proved by the abundant evolution of ammonia on heating in an atmosphere of hydrogen). This body, when treated with dilute sulphuric acid, which readily attacks it, does not, when so acted on, give the least trace of oleaginous matter. Of this I have satisfied myself; but, instead, a solution of ammoniacal sulphate is produced.

To sum up, then, my experiments show the following:—

1. Pure iron does not yield the oil.
2. Iron containing carbon does give the oil.
3. Iron containing nitrogen does not furnish the oleaginous matter.

So far for the origin of this curious body: it now remains for me to determine by analysis its composition, &c. On this subject I am actively engaged at present, and hope to turn to some account the experimental results which I have arrived at

in this paper, so as to furnish me with a means of preparing this oil in larger quantity than I have heretofore obtained it.—*Chem. News, London, July* 6, 1861.

ON ELECTRO-CHEMICAL COLORING AND THE DEPOSITION OF PEROXIDE OF IRON ON PLATES OF STEEL AND IRON.

By M. Becquerel.

Priestly was the first to obtain colored rings by means of electricity, by receiving strong charges from a battery, with a surface of about two square metres, on metal plates, by means of metallic points directed perpendicularly to their surface.

Nobili, in 1827, afterwards produced colored rings on platinum, gold, silver, and brass plates, by putting them in communication with one of the two poles of a voltaic pile, plunging them into metallic and nonmetallic solutions, and then by directing perpendicularly to their surface a platinum point connected with the other pole. With positive silver, for instance, and solution of sea salt, he obtained a series of concentric circles surrounded with irises, the tints being slightly dimmed by contact with the air. On heating the plates all the rings took a red tint.

I began to study the electro-chemical coloration of metals in 1843, my chief object being, not to produce colored rings, but to deposit on plates of gold, platinum, copper, and silver, thin and uniform layers of peroxide of lead presenting successively, according to the duration of the operation, which was generally very short, the rich colors of the spectrum. The operation consists in plunging into an alkaline solution of protoxide of lead the piece to be colored, put in connection with the positive pole of a voltaic pile charged with nitric acid and composed of many layers of plates, and closing the circle with a platinum wire in communication with the negative pole, and of which but the point, which alone touches the alkaline solution, is continually in motion. In contact with the object to be colored, the protoxide of lead, which forms the positive electrode super-oxidises, becomes insoluble in the alkali, and deposits itself on the surface in slight adherent layers, producing the color of the thin plates. Air and light gradually fade

these colors—a disadvantage I have already mentioned, and which may in great measure be avoided by covering the colored surface with alcohol varnish, which acts but very slightly on the peroxide. With a little practice all the tints desired may be given to a large object with hollows and projections, and each part painted with the appropriate color. These colors are now made fast by the processes to be described further on.

If the solution of protoxide of lead in potash is replaced by a solution of protoxide of iron in ammonia, and the gold, copper, or platinum plate by one of polished iron, there is deposited on the latter a layer of peroxide of iron with red or brown tints, which deepen more and more according to the thickness of this stratum, which never exceeds a certain limit on account of the imperfect conductibility of the peroxide.

In a paper on the precipitation of metals from their solutions by other more oxidisable metals, I stated that on plunging a copper plate into a solution of double chloride of potassium and platinum, heated to 60°, the platinum is deposited and adheres to the copper, producing a platinization, which is quickly acted on by the air, taking first a slightly brownish tint, which becomes darker and darker.

This alteration is partly due to the presence of protochloride of copper, which is deposited simultaneously with the platinum towards the end of the operation. The protochloride may be removed by washing the platinized copper with water and acetic acid, or by rubbing its surface with cotton and rouge. The alteration is then avoided, or at least does not appear till long afterwards, probably on account of the air traversing the interstices of the platinum, which with copper forms a voltaic pair. The brownish color of the platinum surface is like that which protochloride of copper ordinarily takes under exposure to air and light.

If we make use of platinized copper directly, it is obtained from a solution of double chloride as a positive electrode to decompose water with a pile composed of several elements, it produces under the influence of the oxygen disengaged from the positive pole, peculiar coloring effects, seeing that the tints pass immediately to blue and deep crimson, and the protochloride of copper

is not modified by light. While in contact with platinum the latter metal doubtless contributes to the coloration. No similar result is obtained by operating with platinized plates previously treated with acidulated water or rouge. Furthermore, air has no effect on the colors produced—not an unimportant fact, as it will make it possible to obtain fast colors also with peroxide of lead.

Owing to the strata of oxide, the result is the same, if heat is gradually applied to non-preserved platinized pieces, but the colors are less brilliant.

If a copper plate with a layer of peroxide of lead giving one of the beautiful colors of the spectrum is employed as a positive electrode to decompose the water, in a few moments it will be found that the coloration is preserved—a result similar to that obtained with platinized copper. By continuing the electro-chemical action for a quarter or half-an-hour, according to the force of the pile, the blue-violet tints fade, turning to green and yellow, as peroxide of lead. The basis of the coloration undergoes no change at the positive pole. It is thought that the acid secondary products formed at the positive pole react on the peroxide and decompose it.

The colored plates thus preserved seem to be in the same condition as iron when it has been plunged in nitric acid, or when it has been used as a positive electrode to decompose this same acid. It is then in an abnormal state, being unattackable by nitric acid.

When a very slight layer of platinum is electro-chemically deposited on a gold or platinum plate by means of a solution of double chloride of potassium and platinum containing no copper, this layer undergoes no change either by the action of the air or when the plate is employed as a positive electrode to decompose water ; but it is otherwise when the solution contains copper. The coloring effects before described are then produced, when the proportion of copper is small and the coloration of the platinum is not destroyed by weak nitric acid—an important advantage practically. In this memoir we have indicated a great improvement in the process of coloration, for by its means more uniform and adherent layers of metals are deposited.

Magnificent coloring effects are produced by a solution of

double chloride of potassium and platinum in hyposulphite of soda.

Lastly, deposits of peroxide of iron on iron and steel, which are already almost unalterable by air, will become entirely so when the pieces have been employed as positive electrodes to decompose water.—*Chem. News, London, July* 6, 1861, *from Comptes-Rendus.*

ON THE PREPARATION OF UREA FROM FERROCYANID OF POTASSIUM.

In the preparation of urea by Wöhler's method the amount obtained always falls short of that which should theoretically be produced. Having remarked that even when the operation is carefully performed with Liebig's proportions, the lixiviate always contains undecomposed cyanid of potassium, it occurred to me to try the effect of a more thorough oxydation, and the result proved very favorable. The following was the course adopted.

Of roasted ferrocyanid of potassium 850 grammes are mixed with 318 grammes of thoroughly dried carbonate of potash in grains, and fused in an iron vessel. When decomposition is complete, the vessel is a little cooled and 1900 grammes of red lead are to be added, not all at once, but 300 to 400 grammes at a time, with intervals of 10 minutes, stirring and keeping up heat enough to retain the whole in a state of fusion.

After the last addition of red lead the mixture is suffered to remain half an hour on the fire to complete the reaction. Heat is applied in all for about four hours. In this way the cyanid of potassium becomes thoroughly oxydized. The process is concluded in the usual manner, and 500 grammes of urea are obtained. No particular precaution is necessary during the fusion, or even the lixiviation with cold water, but in evaporating the solutions the greatest care must be taken to carry off the vapors.—*Silliman's Journal, Sept.* 1861.

(Continued from page 568, Vol. ix.)

the other constituent which forms with oxide of lead an insoluble compound may be a copulated compound. In the examination of the fractional parts which were prepared from this precipitate according to the method described at page 373, vol. ix., attention should be directed to this point, and the method should be employed with hydrochloric acid and baryta (or soda, or potash) as described at pages 469, 561.

In the same manner as directed for the residue which is obtained from the watery decoction treated with sugar of lead, subacetate of lead, and sulphuretted hydrogen, is *the residue dealt with which remains when the watery decoction was filtered through animal charcoal previous to its treatment with the lead salts, and also the residue which remains behind after the precipitation of the watery decoction with alum and ammonia, evaporating and extracting with alcohol, and distilling off the alcohol.* Thus we have in these three examinations a mutual control of the correctness of the results obtained by each individual examination, and consequently a constituent can scarcely be overlooked, and also conclusions may be drawn on the nature of the individual constituents.

II.—*Examination of the cold watery infusion.*

This fluid, prepared in the manner given at page 180, is divided into several parts.

The *first part* is introduced into a test tube, placed in a beaker glass filled with water, and the water slowly heated. By means of a thermometer inserted in the test tube, the temperature is observed. At a certain heat *a coagulation of one or the other constituent* is produced. When the coagulation of the substance is noticed, the lamp is removed from under the beaker glass, or the latter is taken from the sand-bath on which it has been placed to heat it. The object of this removal is to prevent the temperature of the fluid in the test tube rising any farther, and to retain it some time at the same heat, or rather to cool very slowly. The coagulum is separated after the fluid has cooled by the filtration of the fluid. To promote the filtration, it is better to take a number of small filters instead of a larger one, because the pores of the filter are quickly stopped by coagulated material of that kind, and the filtration then proceeds extremely slowly.

The filtrate is again treated as the original fluid, only the temperature is allowed in this second treatment to rise more quickly to the point where the separation takes place, and then slowly elevated. The fluid heated some degrees higher often throws off a fresh coagulum, which is likewise collected on a filter. The filtrate is again heated, to see whether by a still higher temperature a third coagulum makes its appearance. As all coagulable substances do not lose their solubility in water at the same temperature, several of these bodies may be separated from one another when they are simultaneously present in an aqueous extract.

The *second part* of the fluid is mixed with *acetic acid*, to ascertain whether a precipitate results. If a precipitate ensues, it is collected on a filter, of which several small ones are used, instead of a large one. The filtered fluid is now heated, whereby generally a coagulum is formed. The substance precipitated by a little acetic acid is examined, to learn whether it is quite or partially soluble or not in acetic acid when an excess is added. By these means a separation of several of these bodies may be sometimes effected.

The *third part* is, lastly, mixed with *alcohol*, and it is observed whether a precipitate results, which nearly in all cases makes its appearance thereby in at least a small quantity. The precipitate collected on a filter and washed with spirit, is treated with *water*, whereby only in few cases a complete solution results. The filtered aqueous solution resulting is heated, by which frequently a considerable coagulum is thrown out.

III.—*Examination of the extract obtained by acidulated water.*

As already stated (page 181), this extract is employed for the detection of some organic acids, which *per se* are soluble in water, but are contained in the material under examination in the form of compounds, mostly as lime salts, which are neither soluble in pure water nor in spirit. It is also employed for the detection of organic bases. For example, when a part of a plant contains, as is frequently the case, oxalate of lime, the oxalic acid is neither found in the watery decoction nor in the spirituous extract, because oxalate of lime is equally insoluble in water and in spirit. By its decomposition, by means of sulphuric acid, which is added to the water, we obtained from the salt insoluble in water so much oxalic acid in a free state, that we can detect it in the fluid.

For its further investigation the acid extract is freed from its sulphuric acid by *carbonate of baryta*, which is added in small quantity. A precipitate of sulphate of baryta thereby ensues, mixed with more or less compounds of organic substances, or perhaps with precipitated organic bases, when they were present in the acid solution, and one or more of them were difficultly soluble or insoluble in water. The precipitate is collected on a filter and washed with water. The washed precipitate is *boiled with strong spirit*, and the spirituous solution is separated from the insoluble matter by a filter. It is ascertained whether the spirit has dissolved or not any organic bases. The baryta precipitate, boiled with spirit, is digested with dilute sulphuric acid, to produce sulphate of baryta, which is separated by a filter, and to obtain a solution of the substance which was combined with the baryta. The lime and baryta salts generally exhibit a very analogous degree of solubility, so that by this method mostly those compounds are obtained in solution whose lime salts being insoluble in water and spirit, could not be extracted by these fluids from the material under examination. The fluid which is filtered from the sulphate of baryta, excess of

carbonate of baryta and organic baryta compounds, and perhaps precipitated organic bases, is then mixed with *sulphate of copper*, whereby sulphate of baryta is precipitated, when a soluble baryta salt has been formed and is contained in the fluid, as well as many compounds of the oxide of copper with organic substances. The precipitate is filtered off, washed with water, and decomposed under water by sulphuretted hydrogen. The undecomposed sulphate of baryta and sulphuret of copper are filtered off, and a watery solution of the organic substances which were combined with the oxide of copper is thus obtained. The filtrate is heated, for the expulsion of the sulphuretted hydrogen, in a flask or a tubulated retort, in a water bath, during which a stream of carbonic acid is led through the liquid. After this the fluid is mixed with *subacetate of lead* as long as a precipitate ensues. By these means all the acids not precipitated by the copper salt, with few exceptions, are thrown down. The precipitate, after it has been collected on a filter and washed with water, is boiled with *alcohol*, to extract the bases possibly precipitated with the lead compounds. With these some lead salts may of course be dissolved at the same time. The spirit is distilled from the fluid, which has previously been freed from lead by sulphuretted hydrogen, and the bases are sought in the aqueous fluid filtered from the sulphuret of lead. *The fluid filtered from the precipitate produced by basic acetate of lead*, contains in the majority of cases the organic bases. The bases thus separated from most other bodies can be easily discovered therein. A portion of this fluid is employed for the detection of volatile bases, and another portion for the discovery of the bases not distillable with water, according to the directions which are given on these points in the examination of the watery decoction (pages 274, 369, 468.)

The acid fluid which has been obtained by the *digestion of the mixture of baryta salts with dilute sulphuric acid* is, by means of *fractional precipitation*, employed for the detection of the acids contained therein. *Acetate of baryta* is used for the fractional precipitation, which gives better results in this case than acetate of lead.

Volatile as well as non-volatile bases can indeed be separated in a shorter way from the acid extract: the former, by mixing the acid extract with an excess of a solution of potash and distillation: the latter, by infusion of galls and the like precipitants. But thereby we run in danger of overlooking some other constituents. On this account the ceremonious method of analysis here described is to be preferred.

IV.—*Examination of the extract obtained by ammoniacal water.*

This extract, as already mentioned (p. 181), is mixed with dilute hydrochloric acid, and the resulting precipitate, if any, collected on a filter, and washed with water. The precipitate is treated with hot spirit, to learn whether a portion, or the whole, of the precipitate dissolves or not *in*

spirit. Generally the greater part remains behind, which consists of albuminous bodies which are present in a coagulated condition, or, like legumine, are insoluble in a free condition in alcohol and water, but with ammonia afford compounds soluble in water. They are precipitated from their solutions by hydrochloric acid, and remain undissolved by the treatment with spirit. Among the bodies extracted by ammonia and precipitated by hydrochloric acid, and also in the part soluble in alcohol, of the mixture thus obtained, substances often exist which are extracted by alcohol from the material under examination, because they are not soluble in pure water, but are as soluble in ammoniacal water as in spirit; for example, chinovic acid, &c. We often obtain bodies of that kind purer from this ammoniacal extract than from a spirituous extract of the material, in which they are accompanied with many other substances, while in this case many of these substances are separated for the most part by the previous boiling with pure water, and thus do not interfere with their preparation in a pure state. It often happens *that substances combined with lime or magnesia are quite as insoluble in water and spirit as in ammoniacal water. When the substance combined with lime or magnesia is insoluble in acidulated water,* it can only be obtained in the following way from the material:—A portion of the material, boiled with water, is extracted with water containing hydrochloric acid, whereby the lime and magnesia compounds in question are decomposed, and the lime and magnesia dissolved as chlorides and removed. All that is soluble is separated by washing with pure water, and then the material is extracted with ammoniacal water, which now dissolves the organic body rendered free, which was insoluble as a lime or magnesia compound, and may be precipitated insoluble in water upon the addition of hydrochloric acid. *By the decoction of the material with spirit containing sulphuric acid,* after it has been already exhausted with spirit, these bodies may be obtained likewise; but we are in danger, by the action of the acid in the heat, of producing changes in the bodies we desire to isolate.

V.—Examination of the Spirituous Extract or Decoction.

a.—Deposits from the spirituous extract or decoction.

From the spirituous extract of the substance under examination, when the extract is prepared with hot alcohol, bodies are deposited sometimes by its cooling, or after a portion of the spirit has been distilled off, which must be subjected to a closer examination. With a cold prepared infusion, deposits of that kind make their appearance generally after the distillation of the alcohol, but mostly in smaller quantities. Resins, kinds of wax, fats, with other peculiar bodies which belong to none of these classes—as, for example, saponine—are contained in these deposits, which frequently appear of a dark green color like the spirituous extract itself, when vegetable substances containing chlorophyll have been extracted with spirit.

Probably these might be partially separated by the employment of sulphuret of carbon, and thus the analysis facilitated. Unfortunately, at present such a few data lie before us upon the applicability of this fluid, which was first employed by Lampadius for separations of that kind, that I am not in a position to give more information with regard to the employment of this body in the treatment of the mixtures in question. So much is certain, that the analysis of these mixtures belongs often to the most difficult problems. As all fats, as well as kinds of wax, dissolve at least in hot ether, but only some of the resins, it is convenient to effect a separation by ether into a soluble part, and a part insoluble therein, and to examine both after distilling off the ether more closely, supposing that the whole mass is not soluble in ether, which often happens. Some bodies in such mixtures are soluble in hot or boiling alcohol, and sparingly soluble in cold alcohol, as, for example, some kinds of wax. A partial, though not an exact separation, can be effected by dissolving the mixture in the smallest possible quantity of *boiling alcohol*, and then cooling the solution. I shall come directly to another method for the separation of this mixture into its constituents. But I must here remark that fats, when present in great quantity, as, for example, in the seeds poor in starch or in some roots, are seldom accompanied by resins in considerable quantity, and *vice versâ*, leaves, woods, flowers, &c., rich in resin, contain seldom more than a trace of fat, so that we have to do either with a preponderance of fats, or a preponderance of resins, at least in the majority of cases. On the contrary, with resins, waxy substances frequently exist together. It has been already stated that vegetable bodies rich in fat are freed generally by pressure from the bulk of the fat, and the quantity of fat necessary for its investigation can be obtained almost in a pure condition. And it has likewise been mentioned before that the expressed residues, as well as such material which cannot be freed from its fat by pressure, are to be exhausted with a weaker alcohol in order to obtain alcoholic tincture as free from fixed oil as possible.

I have therefore to give the method by which a mixture of resins containing waxy bodies and a mixture of fats are to be treated, to ascertain the individual constituents of these mixtures. *The mixture of resins*, which contains admixed waxy bodies, must, before it is submitted to investigation, be subjected to some preliminary experiments, which are performed with small quantities of it. *A small portion of the resinous mixture* is treated in a mortar with water to which a little ammonia has been added, and the resinous mass is kneaded with the pestle into the closest possible contact with the alkaline fluid. Many resins possess the character of weak acids. These resins *dissolve in the ammoniacal water*, while the indifferent resins remain undissolved by this treatment. By filtration the undissolved substances are separated from the solution, and from this the dissolved resins are thrown down by dilute hydrochloric acid. By these means the

resinous mass is divided into two parts. *A second portion* of the resinous mixture is dissolved in spirit, when the method named effects no separation. But when a separation has been thereby effected, the part soluble in ammonia is dissolved in spirit. The spirituous solutions are mixed with *a solution of acetate of copper*, whereby some resins, but not all, are precipitated. *A third portion* of the resinous mixture is treated with ether, to effect, if possible, a separation. Both portions of resin which have been separated from one another by ammoniacal water are treated with ether, to produce a further separation. *A fourth greater quantity of the resinous mixture* is treated in the following manner:—The mixture is dissolved in spirit, and the solution precipitated with a *spirituous solution of acetate of lead* as long as a precipitate results. The fluid is separated from the precipitate by a filter, and this is washed on the filter with spirit. The washed precipitate is diffused in spirit, and a current of *sulphuretted hydrogen* is passed into the fluid, which is made hot by surrounding the vessel in which it is placed with hot water. After its complete decomposition, the solution is filtered hot from the sulphuret of lead in a water bath funnel. By the cooling of the filtrate the bulk of the substance separates which was previously combined with the lead. A portion often remains dissolved, which may be procured by evaporation. Frequently in this way crystalline waxy compounds are obtained by cooling separated from the resins, while sometimes one resin or the other remains dissolved in the fluid. The fluid which is filtered from the precipitate which has been produced by the spirituous solution of acetate of lead, in the spirituous solution of the resinous mixture, is treated with sulphuretted hydrogen. The lead, as well as the chlorophyll when present, are thereby precipitated from the fluid. The sulphuret of lead is separated by filtration, and the spirit of the solution by distillation, whereby the resins are precipitated. For the prevention of any alteration by heat, the distillation is undertaken in a water bath. The *resins* thereby obtained are treated with a *weak solution of caustic potash*, which separates the soluble from the insoluble part. The resulting solution is mixed with a watery solution of *chloride of calcium*, the resulting precipitate washed on a filter, and then dried by a gentle heat or *in vacuo*. The filtered fluid is mixed with *hydrochloric acid*, whereby a precipitate frequently makes its appearance, which is collected on a filter, washed with water, and then dissolved in *lime water*. A current of *carbonic acid gas* is conducted into the solution, by which a precipitation of organic substances often appears, which are separated from the combinations with lime by the carbonic acid. As this precipitate is contaminated with carbonate of lime, the salt is extracted with *dilute hydrochloric acid*, or the organic substances are separated from the lime salt *by alcohol*. The fluid filtered from the carbonate of lime and the organic substances is heated for the decomposition of the bicarbonate of lime present. The fluid is again filtered, and, when cold, treated with *dilute hydrochloric acid*, by which a

precipitate of organic substances results, which, as stronger acids, were not thrown down by the carbonic acid from the lime. The *lime salt*, prepared by precipitating with *chloride of calcium*, the solution which was obtained by means of potash, is, after it is dried, treated with *ether*, which generally dissolves a portion of it, which is left behind by distilling off the ether in a water bath. The portion remaining undissolved in ether is treated with *alcohol*, which sometimes likewise dissolves a small portion. Lastly, that which is insoluble in ether and alcohol, is treated with *dilute hydrochloric acid* without the application of heat, for the separation of the lime. With these individual portions we shall have the opportunity of ascertaining which method of separation possesses the advantage over the others, and to treat correspondingly the whole mass of the resinous mixture.

When we have to operate on a *mixture of fats* which has been procured either by pressure between cold or heated plates, or by the extraction of the material with hot spirit, and distilling off the spirit and filtering the watery residue through a moist filter, whereby the fat remains on the filter, we proceed in the following way:—

A small portion of the fat is saponified with a solution of potash in a dish, *the solution of soap decomposed by a sufficient quantity of dilute sulphuric acid*, and the floating fatty mass separated from the watery fluid by a pipette or a small syphon; this fluid is *subjected to distillation* in a flask or a retort, after a refrigeratory apparatus and receiver have been connected with the distilling vessel. The distillate is tested after about two-thirds of the fluid have passed over, and the distillation is interrupted to ascertain whether it has or not an acid reaction, whether turbid or clear, whether oily globules have separated thereout, and whether it possesses an odor or not. When the distillate exhibits only a slight acid reaction, is almost odorless, quite clear, and no oily globules float on its surface, no glyceryle compounds of the *volatile fatty acids* are present in quantity. On the other side, they are present when the distillate has a strong acid reaction, has thrown out oily globules, or at least when these render the distillate turbid or opalescent, and has a remarkable odor. *If no volatile fatty acids are present, the bulk of the fatty mixture is saponified with a solution of potash, the solution of soap mixed with common salt*, and the soap formed is separated. The soap is removed after some time from the aqueous fluid, and dissolved in water with the aid of heat. The solution is again treated with common salt, and the solution and the salting repeated frequently, until the watery saline fluid takes up no more foreign substances. *In the first ley*, from which the soap has been separated by common salt, is contained the chief bulk of the *glycerine; the soap* which has been purified by repeated solution and salting, is now *dissolved in water*, and precipitated with *a solution of sugar of lead;* the precipitate which results is a mixture of lead compounds, consisting of the lead salts of the fatty acids. This mixture of lead salts, after it has been washed and dried,

is treated with *ether*, whereby the lead compounds of the liquid fatty acids are dissolved, but not those of the solid fatty acids, and which, after being washed with ether, are decomposed, which can be accomplished either by spirit containing sulphuric or hydrochloric acid, or by treatment with spirit and sulphuretted hydrogen. The fatty acids, freed from lead, and dissolved in spirit, are, after the greatest portion of the spirit has been distilled off, mixed with a solution of carbonate of potash as long as an effervescence thereby ensues, and then the spirit is entirely expelled by evaporation. A little solution of caustic potash is now added, and the whole boiled to decompose a small quantity of the ethers of the fatty acids, which have formed by the decomposition of the lead salts with the spirit containing sulphuric or hydrochloric acid, and by the distillation of the spirit, have not quite volatilized, and to combine the fatty acids contained therein with potash. The excess of alkali is separated by salting the soap, which is then dissolved in water. *This solution of the potash salts of several fatty acids is now fractionally precipitated with acetate of magnesia, acetate of baryta, or acetate of lead*, according to the method of Heintz, by adding half of a solution of these salts, which would have sufficed to throw down the whole of the fatty acids. The precipitate is filtered off, and washed. To the filtrate, the second half of the solution of the acetate employed is added, and the precipitation is thus completed. Both precipitates are now decomposed, and both resulting portions of the fatty acids are converted into ammoniacal salts in solution, and these solutions each again divided into two parts, and precipitated by the acetate selected. This method of separation is continued until only one fatty acid is in combination with magnesia, lead, or baryta, in the individual parts. We learn whether the separation has been brought thereby to this point by decomposing a portion of a lead magnesia, or baryta salt, converting the fatty acid or acids into a silver salt, and determining the atomic weight of the acid by heat. The bulk of the lead, magnesia, or baryta salt is then decomposed, of which a small portion has been taken for the preparation of the silver salt used for the determination of the atomic weight; the resulting free acids converted into ammoniacal salts, and these fractionally precipitated. After a silver salt has been prepared from the first and second half, the atomic weights of both silver salts are determined. When the atomic weight or the organic substance of both silver salts is the same, and equal to the atomic weight of the silver salt first estimated, the separation in this examined portion has been a complete one.

If not only *glyceryle compounds* of the non-volatile fatty acids, but those of the volatile acids, are contained in the fats, the method is modified in the following way:—The saponification is performed in a still, the *solution of soap* therein mixed with a solution of *tartaric acid*, and the whole subjected to *distillation*. After the head has been fixed, and a careful arrangement made for cooling, the volatile fatty acids are then found in the *distillate*, the non-volatile ones among the contents of the still. The distil-

(To be continued.)

Varieties.

On the fixed oil and Tannin in the Seeds of the Grape. By M. R. Wagner.—The grapes which yielded the seed were raised in a vineyard on the shores of the Rhine, in 1858. Dried at 212°, these seed contained 10·8 to 11·2 per cent. of fixed oil, and 6·5 to 7·3 per cent. of tannin. 100 parts of the stems perfectly ripe and dry, contain 6·2 to 7·3 per cent. of tannic acid.

The author proposes to utilize these seeds, by extracting the fixed oil with sulphuret of carbon, and then to employ the astringent residues for tanning and drying purposes.—*Journ. de Pharm., Nov.* 1861.

Diamonds.—In the official statistical report of the value of produce exported from Bahia, Brazil, an amount is included not exceeding 150,000*l.*, whereas an amount superior to 500,000*l.* worth of this precious stone is clandestinely sent out of the country yearly. The discovery of the diamond mines in the district of Paraguassú, in the year 1845, has effected great and beneficial results to the population and commerce. What was in that year but a desert, is now one of the most flourishing districts, inhabited by a laborious and daily-increasing population. The town of Isabel de Paraguassú and neighborhood contain 60,000 souls; that of Lencoés, 30,000; and Andarahy, 20,000—all the results of this discovery; and it may truly be said that those mines have realized for the poorer population of the interior, the same good we have observed in California and Australia. It has opened a large field to all, without dependence on professional skill or capital, of which the majority were not possessed; and in a moral sense has operated wonders in reclaiming the vicious from habits of indolence and crime. These men, finding in the extraction of diamonds an advantageous profit, naturally became large consumers of the produce of the country, which, for the want of market, was not cultivated; and altering their habits of life, increased their well-being, and eventually made them consumers of the produce of foreign countries. The town of St. Isabel de Paraguassú is now the chief depôt of the trade of the north-west of this province, and supplies all the interior populations with the comforts of European civilization, a population calculated at no less than 700,000 souls. In the neighborhood of St. Isabel the cotton plant flourishes, and nitrate of soda is found—but the great difficulty to the exportation of these valuable products is the want of a good road to this port.

Last year I used all my influence and endeavors with the late President to promote the passing of a law in the Assembly, guaranteeing five per cent. on the capital expended in the construction of a good carriage road. The law was passed and duly sanctioned by the late President, but, unfortunately, that law has been revoked. To give an idea of the importance of the road in question, it it is enough to state that goods (foreign) to the value of 600,000*l.* to 1,000,000*l*, sterling are annually sent to the diamond district from this city, and that its exports in diamonds average between 600,000*l.* to 800,000*l.* per annum; no calculation being possible of the value of cotton, nitrate of soda, hides, skins, cattle, iron, &c. &c., that would be sent down, had the road I had so strongly recommended been carried into execution.—*Chem. News, London, Sept.* 14, 1861, from *Extract from the Report of H. B. M. Consul.*

Influence of Sulphur on Fermentation.—When finely-powdered sulphur is placed in grape juice, Leuchs says the fermentation goes on as usual with the formation at the same time of a good deal of sulphuretted hydrogen. If the must is not too much diluted with water, there is a smell, and even taste resembling that of garlic or onions, but when diluted, the smell is more like that of liver of sulphur. The sugar appears to be decomposed but slowly, for the fluid remains sweet a long time. Leuchs suggests that mineral waters, containing sulphuretted hydrogen and carbonic acid, may be prepared by fermenting with a little sulphur. Grapes which have been dusted over with sulphur to cure the disease, the author says, give wine that smells of sulphur, but loses the smell in six months, in consequence of the oxidation of the sulphur. Powdered sulphur added to a solution of grape sugar excited no fermentation in the first eight days. Afterwards the fluid became cloudy, and sulphuretted hydrogen was evolved. The fluid passed through filtering paper with great difficulty, and gum appeared to have been formed.

Colorless Caoutchouc Varnish.—Dr. Bolley recommends to cut the caoutchouc into small strips, and digest them in benzine, at the ordinary temperature; stirring or shaking the mixture frequently and long. The jelly which forms is partly dissolved, and gives a liquid heavier than benzine, which may be made nearly colorless by filtration and repose. By pressing the residuum in a strong cloth, may be obtained a dark colored insoluble jelly, which makes a good adhesive covering. It incorporates well with all the fat and volatile oils, and dries rapidly: the surface is not shining. It is very flexible, and may be spread in thin coats.—*Dingler's Polytech. Jour. Bull. Soc. d'Encour pour l'Indus. Nat.*

The Working power of Coal.—Professor Rogers estimates that nearly one-sixth of the total annual produce of our coal mines is used for the pro-

duction of mechanical power alone, from which a power equal to that of 66,000,000 able bodied men is obtained. Each acre of a seam yielding three feet of pure fuel, is equal to about 5000 tons, and possesses a reserve of mechanical strength equal to the labor of 1600 men during their whole life; and each square mile of the same bed contains 8,000,000 tons of fuel which is equal to 1,000,000 men laboring through twenty years of their ripe strength. Upon the same calculation, the total annual coal production of the United Kingdom (65,000,000 tons) is equal to the strength of 400,000,000, strong men, or more than double the number of adult males now upon the globe.—*Lond. Mech. Mag., Sept.* 1861.

India-Rubber Stoppers for Bottles. Messrs. Editors,—Will you allow me to call the attention of the profession, through your pages, to a recent invention which promises to be of great convenience to physicians, as well as to all other classes of the community. I refer to the India-rubber corks for bottles and vials. By means of this admirable substitute for the common cork, bottles containing the strongest acids may be carried without danger in the pocket, and the great inconvenience and expense of ground-glass stoppers obviated. The vulcanized rubber of which they are made will resist, I believe, all chemical agents. I have kept a bottle of concentrated sulphuric ether, closed with one of these stoppers inverted for several days, without the slightest visible effect being produced on the gum.

For alcohol, solutions of nitrate of silver, tincture of iodine, the various mineral acids, and indeed, for all liquids, the India-rubber stopper is more than a convenience, it is a positive luxury, as, I am confident, all will agree who have tried it. To practitioners in the country, who carry their own medicines with them, it will be of inestimable advantage. In the sick room, also, the new stopper is of very great utility. By means of it, bottles containing effervescing fluids, such as champagne, citrate of magnesia, soda-water, &c., can be tightly corked again after having been opened, so that small quantities of their contents may be used at a time without the slightest detriment to the remainder. Lastly, and not least, these corks are sold at a price which will place them within the reach of all. M.—*Boston Med. and Surg. Journ.*, Dec. 12, 1861.

Reputed Specific for Small-pox—At the last meeting of the Epidemiological Society, a communication was read from Mr. Herbert Miles, Assistant Surgeon to the Royal Artillery, respecting a plant that was stated to be a specific for small-pox. The remedy is given in the form of a strong infusion of the rhizome, and Mr. Miles had, after very considerable difficulty, succeeded in obtaining a small supply of the plant, which he had forwarded to the Society.

Mr. Miles is quartered in Canada, where an epedemic of small-pox having broken out among the Indians, the disease had proved virulent in the ex-

treme among the unprotected, because unvaccinated, natives. However, the alarm had greatly diminished on an old squaw going amongst them, and treating the cases with the infusion. This treatment, it is said, was so successful, as to cure every case. The Secretary of the Society, Dr. McWilliam, C. B., had sent specimens of the plant to Dr. Hooker, of Kew, who pronounced it to be the *Sarracenia purpurea*, one of the pitcher plants of North America.

Mr. Marson, of the Small-Pox Hospital, has kindly undertaken to give the so-called remedy a trial.—*London Pharm. Jour., December*, 1861.

Carbonized Rye as a Tooth Powder.—Rye charcoal is said to be much used in Paris as a tooth powder. The following constituents have been found by Schrader in 500 grammes of the ashes of rye: Carbonate of lime, 7 grammes; 9·8 ditto of carbonate of magnesia; 7·2 ditto of oxides of iron and manganese, and 1.9 ditto of silica.—*Ibid.*

The Action of Porous Bodies in Inducing Chemical Combinations.—M. B. Corenwinder showed some years ago that partial combination of sulphur and hydrogen may be effected by bringing the two bodies together in the presence of pumice-stone at a red heat. He has recently shown that the vapor of water may be also decomposed by sulphur, when some porous body at an elevated temperature is made to intervene. The experiment was conducted as follows:—Some fragments of recently calcined pumice stone were placed in the middle part of a glass or porcelain tube; one end of the tube was then filled with pieces of sulphur, a plugget of asbestos being placed between the cork and the sulphur. A tube, by which steam could be sent in, passed through the cork. The pumice-stone was then heated to redness, and the sulphur made to slowly volatilize. At the same time a current of steam was cautiously sent through. After a little time, sulphuretted hydrogen was produced in abundance. A still more decided result is obtained if pure calcined silica be substituted for the pumice-stone. The porous body is totally unacted upon in all cases.

The author directs the attention of geologists to these results; he thinks that they may explain the presence of sulphuretted hydrogen in certain volcanic emanations.—*Ibid.*

Formation of Fatty Matter in Olives.—The cause of the formation of the different fatty and other principles which exist in plants is at once a most interesting problem to be solved, and one upon which but little light has hitherto been thrown. M. de Luca has endeavored to solve it with regard to the oily principle of olives, but he has only succeeded in establishing certain relations between the density of this fruit and its richness in oil.

Thus he found that in perfectly ripe olives the density had obtained its minimum, and the oil its maximum, a result which it was easy to foresee. M. de Luca has found *mannite*, not only in the olives themselves, but also in the different organs of the olive plant, and particularly in the leaves. This saccharine matter is easily extracted by the employment of boiling alcohol, which deposits upon cooling. It appears to be connected with the production of the fatty matter.—*Ibid, from L' Union Pharmaceutique.*

Editorial Department.

Our Journal.—The Thirty-fourth Volume, the 10th of the Third Series, begins with this number, and it is the wish of the Publishing Committee to continue the work uninterruptedly, notwithstanding the depressed condition of business, and the large falling off of subscribers consequent upon our national difficulties. Will our friends who are in arrears enable us to do so by giving their attention to their dues? We hope they will cheerfully do so, and save us from the necessity of diminishing the size of our volume.

The American Pharmaceutical Association.—It is time that the members of the Association should consider the subject of the next meeting, as to when and where. At the present moment, the prospect for a full meeting is exceedingly unfavorable; but will it not be better to have a meeting, even though it be small, rather than let another year pass without leaving a record of our progress? It may be premature to offer a decided opinion at this time, in view of the unsettled state of public affairs, but we feel willing to suggest—1st, that it will be impolitic to meet west of the Alleghanies; and 2d, that Philadelphia will, under all the circumstances, be the most appropriate place; and 3d, that the time proposed for the St. Louis meeting will be more suitable to the convenience of those at a distance than later. Let the members then look forward to a meeting in 1862, and gather together observations and results that will give interest to the occasion, and if they cannot come, let them send their papers to the meeting by those who can come.

Military Pharmaceutists.—Occasionally, for many years past, apothecaries have been employed on some of our naval vessels to facilitate the duties of the surgeon; but from the fact that no rank attaches to the

position, we are told, it is but little sought after, as the "Surgeon's mate" is socially ill situated on ship-board. We are not aware that the apothecary has heretofore been employed in the medical department of the "regular" army of the United States. The immense extension of this service at the present time has caused in many of the volunteer regiments the employment of apothecaries, especially in the regimental hospitals. The vital importance of an efficient and intelligent service in dispensing aid and medicines both on the battle field and in the general and camp hospitals is so self-evident, that it will undoubtedly claim the attention of the proper authorities. To make this service more effective, it should be separated sufficiently from that of the surgeon to give a distinct standing and rank to the pharmaceutist, as in the French army, with clearly defined duties, that his proper self-respect, and ambition to be eminent in his sphere, may have ample room for display. Unless such an arrangement can be made, it is not probable that the better class of graduates in Pharmacy would seek positions of this kind.

MEDICAL AND OTHER EXCHANGES.—From the numerous suspensions of medical journals, our exchange list has been considerably decreased, and as we have not received "The Druggist" lately, we fear it has had to succumb to the times. Whilst on this subject, we will remind the editor of the "Chemical News," London, that we have never received a single copy of his journal in exchange, as agreed to, although we have provided an agency in London to receive it. Meanwhile our journal has been regularly sent to him through Bailliere, Bros. & Co. Will he send the numbers for the year 1861 to the address on the fourth page of our cover, or does he decline the exchange?

The Physician's Visiting List, Diary, and Book of Engagements for 1862. Philad. Lindsay & Blakiston.

This excellent little annual was placed on our table some months ago, and by accident was overlooked. It is cheerfully recommended as a valuable aid to the practitioner in helping the memory in the daily routine of practice.

CATALOGUE OF THE CLASS OF THE PHILADELPHIA COLLEGE OF PHARMACY.

FOR THE FORTY-FIRST SESSION, 1861—62.

With a List of their Preceptors and Localities.

Matriculants.	Town or County.	State.	Preceptors.
Abel, Jacob W.	Philadelphia,	Pennsylvania.	John Moffet.
Adams, J. Montreville		New Jersey.	Thomas Weaver.
Allen, Wm. M.	Philadelphia,	Pennsylvania.	Jenks & Middleton.
Bachmann, Adolphus	"	"	Adam H. Wilson.
Berger, Christian	"	"	Charles Ellis & Co.
Blithe, Henry	Montgomery,	"	Gaillard & Marshall.
Brown, Albert P.	Philadelphia,	"	m. B. Webb.
Bourke, Joseph M.	"	"	John Gegan, M. D.
Buchanan, W. G.	"	"	Samuel Gerhard.
Buehler, Edward H.	Harrisburg,	"	Wyeth & Bro.
Caspar, Thos. J., M.D.	Philadelphia,	"	
Chipman, Ed. D.	Frankford,	"	J. T. Farr.
Clark, Edward B.	Portsmouth,	Ohio.	John C. Baker & Co.
Coggins, Franklin	Philadelphia,	Pennsylvania.	Bullock & Crenshaw.
Collom, Charles D.	"	"	Wetherill & Bro.
Combs, Matthew	"	"	Matthew Combs.
Cooper, Wm. Henry	Greensboro,	Maryland.	Jas. L. Bispham.
Croft, Henry C.	Philadelphia,	Pennsylvania.	H. C. Blair.
Dickson, Robert W.	"	"	F. Brown.
Diehl, C. Lewis	Chicago,	Illinois.	J. R. Angney, M. D.
Dobbins, Edward T.	Philadelphia,	Pennsylvania.	Wyeth & Bro.
Eldridge, Geo. W.		New Jersey.	Geo. J. Scattergood.
Fetter, Marcus C.	Bethlehem,	Pennsylvania.	C. H. Eggert.
Fox, Daniel S.	Reading,	"	H. A. Bower.
Fugate, E. L.	Philadelphia,	"	Asa Jones.
Givens, John	"	"	Wm. M. Reilly, M. D.
Greiner, A. Welden	"	"	Wm. Evans, Jr.
Gristock, Charles F.	"	"	C. Fronefield.
Hance, John C.	"	"	R. A. Hance.
Halpin, Wm. J.	"	"	Geo. D. Wetherill & Co.
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Hansel, George	Rancocas,	"	Richards & Co.
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Israel, Julius		Germany.	G. Mannel
Jacobs, Henry H.	Philadelphia,	Pennsylvania.	Wetherill & Bro.
John, H. P.	"	"	D. Jayne & Son.
Jones, Woodruff	"	"	Crew, Bro. & Co.
Kirkbride, Joseph C.	Camden,	New Jersey.	J. C. Delacour.
Knorr, Andrew K.	Philadelphia,	Pennsylvania.	A. K. Knorr.
Kunkel, S. A.	Middletown,	"	Wm. Hodgson, Jr.
Lehlbach, P. Fred'k	Newark,	New Jersey.	Wm. Wider.
Leslie, Henry W.	Bristol,	Pennsylvania.	H. W. Leslie.
Lobb, Henry W.			J. G. Kline.

Matriculants.	Town or County.	State.	Preceptor.
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Lungren, Edwin F.	Philadelphia,	"	John W. Simes & Son.
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McIntyre, Wm. G.	"	"	John Bley.
Magill, Robert D.	Danville,	"	Ed. L. Thomas.
Marple, Enoch W.	Philadelphia,	"	John C. Savery.
Mellor, Alfred	"	"	Bullock & Crenshaw.
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Miller, Adolph W.	Saint Paul,	Minnesota.	H. O. D. Banks.
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Morell, Elijah S.	"	"	Charles Morell.
Mullen, Wesley W.	"	"	Charles Ellis & Co.
Murray, T. C.	Carlisle,	"	Thomas S. Wiegand.
Naulty, W. H.	Philadelphia,	"	Geo. D. Wetherill & Co.
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Notson, G. W.	"	"	Wm. M. Notson, M. D.
O'Reilly, Robert		"	Charles Ellis & Co.
Parry, George R.	"	"	Charles Ellis & Co.
Peck, H. T.	"	"	C. L. Eberle.
Perkins, John S.	"	"	Peter Niskey.
Preston, David	Harford Co.	Maryland.	Wm. Procter, Jr.
Reeder, W. D.	Philadelphia,	Pennsylvania.	Wm. B. Hartman.
Rex, Thomas A.	"	"	E. Parrish.
Rohrer, Earl Penn	"	"	Thomas Estlack, Jr.
Romberg, W. Fred.		Germany.	Wm. Macpherson.
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Schmidt, Christian	Baltimore,	Maryland.	Theo. Brandes, M. D.
St. Clair, Theo. A.	Philadelphia,	Pennsylvania.	A. B. Taylor.
Segner, Wm.	Palmyra,	"	J. P. Fitler, M. D.
Sellers, Charles P.	"	"	H. F. Sellers, M. D.
Senneff, Jacob	"	"	S. Warner.
Shallcross, Aaron P.		Ohio.	E. Parrish.
Shoemaker, R. M.	Philadelphia,	Pennsylvania.	Thomas P. James.
Smedley, Bennett L.	Delaware Co.	"	A. H. Yarnall.
Smyser, George M.	York,	"	Wm. Procter, Jr.
Snyder, J. B.	Marietta,	Ohio.	J. B. McClean, M. D.
Sterne, W. Henry	Philadelphia,	"	A. F. Hazard & Co.
Stevenson, Howard A.	"	"	Ziegler & Smith.
Tait, Stewart	"	"	Roger Keys.
Thomas, Chester S.	"	"	Hughes & Coombe.
Thomas, Edwin	Quakertown,	"	J. T. Shinn.
Thomas, Jason P.	Tamaqua.	"	Henry C. Blair.
Tredenick, J. B.	Columbia,	"	House of Industry.
Tobias, Snyder		"	L. E. Nordman.
Tomlinson, Edwin	Haddonfield,	New Jersey.	Henry C. Blair.
Wells, Clayton N.	Rancocas,	"	Charles Ellis & Co.
Witmer, D. L.	Philadelphia,	Pennsylvania.	A. H. Yarnall.
Zacharias, S. M.	Mechanicsburg,	"	Beates & Miller.